THE

POPULAR SCIENCE MONTHLY.

JULY, 1884.

THE GREAT POLITICAL SUPERSTITION.

By HERBERT SPENCER.

THE great political superstition of the past was the divine right of kings. The great political superstition of the present is the divine right of parliaments. The oil of anointing seems unaware to have dripped from the head of the one on to the heads of the many, and given sacredness to them also and to their decrees.

However irrational we may think the earlier of these beliefs, we must admit that it was more consistent than is the latter. Whether we go back to times when the king was a god, or to times when he was a descendant of a god, or to times when he was god-appointed, we see valid reason for passive obedience to his will. When, as under Louis XIV, theologians like Bossuet taught that kings "are gods, and share in a manner the Divine independence," or when it was thought, as by our own Tory party in old days, that "the monarch was the delegate of heaven," it is clear that, given the premise, the inevitable conclusion was that no bounds could be set to governmental commands. But for the modern belief, such a warrant does not exist. Making no pretension to divine descent or divine appointment, a legislative body can show no supernatural justification for its claim to unlimited authority; and no natural justification has ever been attempted. Hence, belief in its unlimited authority is without that consistency which of old characterized belief in a king's unlimited authority.

It is curious how commonly men continue to hold in fact, doctrines which they have rejected in name—retaining the substance after they have abandoned the form. In Theology an illustration is supplied by Carlyle, who, in his student-days, giving up, as he thought, the creed of his fathers, rejected its shell only, and kept the contents—was proved

by his conceptions of the world, and man, and conduct, to be still among the sternest of Scotch Calvinists. Similarly, Science furnishes an instance in one who united naturalism in Geology with supernaturalism in Biology—Sir Charles Lyell. While, as the leading expositor of the uniformitarian theory in geology, he ignored wholly the Mosaic cosmogony, he long defended that belief in special creations of organic types, for which no other source than the Mosaic cosmogony could be assigned; and only in the latter part of his life surrendered to the arguments of Mr. Darwin. In Politics, as above implied, we have an analogous case. The tacitly-asserted doctrine, common to Tories, Whigs, and Radicals, that governmental authority is unlimited, dates back to times when the lawgiver was supposed to have a warrant from God; and it survives still, though the belief that the lawgiver has God's warrant has died out. "Oh, an Act of Parliament can do anything," is the reply made to a citizen who questions the legitimacy of some arbitrary state interference; and the citizen stands paralyzed. It does not occur to him to ask the how, and the when, and the whence, came this asserted omnipotence, bounded only by physical impossibilities.

Here we will take leave to question it. In default of the justification, once logically valid, that the ruler on Earth being a deputy of the ruler in Heaven, submission to him in all things is a duty, let us ask what reason there is for asserting the duty of submission in all things to a ruling power, constitutional or republican, which has no heaven-derived supremacy. Evidently this inquiry commits us to a criticism of past and present theories concerning political authority. To revive questions supposed to be long since settled, may be thought to need some apology; but there is a sufficient apology in the implication above made clear, that the theory commonly accepted is ill-based or unbased.

The notion of sovereignty is that which first presents itself; and a critical examination of this notion, as entertained by those who do not postulate the supernatural origin of sovereignty, carries us back to the arguments of Hobbes.

Let us grant Hobbes's postulate that, "during the time men live without a common power to keep them all in awe, they are in that condition which is called war . . . of every man against every man"; * though this is not true, since there are some small societies in which, without any "common power to keep them all in awe," men maintain peace and harmony better than it is maintained in societies where such a power exists. Let us suppose him to be right, too, in assuming that the rise of a common ruling power over associated men, results from their desires to preserve order among themselves; though, in fact, it habitually arises from the need for subordination to a leader in war,

* Hobbes's "Collected Works," vol. iii, pp. 112, 113.

defensive or offensive, and has originally no necessary, and often no actual, relation to the preservation of order among the combined individuals. Once more, let us admit the indefensible assumption that to escape the evils of chronic warfare, which must otherwise continue among them, the members of a community enter into a "pact or covenant," by which they all bind themselves to surrender their primitive freedom of action, and subordinate themselves to the will of a ruling power agreed upon;* accepting, also, the implication that their descendants forever are bound by that covenant which their great-great-great, etc., grandfathers made for them. Let us, I say, not object to these data, but pass to the conclusions Hobbes draws. He says:

> For, where no covenant hath preceded, there hath no right been transferred, and every man has right to every thing; and, consequently, no action can be unjust. But when a covenant is made, then to break it is *unjust*, and the definition of INJUSTICE is no other than *the not performance of covenant*. . . . Therefore, before the names of just and unjust can have place, there must be some coercive power to compel men equally to the performance of their covenants by the terror of some punishment greater than the benefit they expect by the breach of their covenant.†

Were people's characters in Hobbes's day really so bad as to warrant his assumption that none would perform their covenants in the absence of a coercive power and threatened penalties? In our day "the names of just and unjust can have place" quite apart from recognition of any coercive power. Among my friends I could name half a dozen whom I would implicitly trust to perform their covenants without any "terror of some punishment"; and over whom the requirements of justice would be as imperative in the absence of a coercive power as in its presence. Merely noting, however, that this unwarranted assumption vitiates Hobbes's argument for State-authority, and accepting both his premises and conclusion, we have to observe two significant implications. One is that State-authority, as thus derived, is a means to an end, and has no validity, save as subserving that end: if the end is not subserved, the authority, by the hypothesis, does not exist. The other is, that the end for which the authority exists, as thus specified, is the enforcement of justice—the maintenance of equitable relations. The reasoning yields no warrant for other coercion over citizens than that which is required for preventing direct aggressions, and those indirect aggressions constituted by breaches of contract; to which, if we add protection against external enemies, the entire function implied by Hobbes's derivation of sovereign authority is comprehended.

Hobbes argued in the interests of absolute monarchy. His modern admirer, Austin, had for his aim to derive the authority of law from the unlimited sovereignty of one man, or of a number of men, small

* Hobbes's "Collected Works," vol. iii, p. 159. † Ibid., pp. 130, 131.

or large, compared with the whole community. Austin was originally in the army; and it has been truly remarked that "the permanent traces left" may be seen in his "Province of Jurisprudence." When, undeterred by the exasperating pedantries—the endless distinctions and definitions and repetitions—which serve but to hide his essential doctrines, we ascertain what these are, it becomes manifest that he assimilates civil authority to military authority: taking for granted that the one, as the other, is above question in respect of both origin and range. To get justification for positive law, he takes us back to the absolute sovereignty of the power imposing it—a monarch, an aristocracy, or that larger body of men who have votes in a democracy; which body he also styles the sovereign, in contrast with the remaining portion of the community, which, from incapacity or other cause, remains subject. And having affirmed, or rather taken for granted, the unlimited authority of the body, simple or compound, small or large, which he styles sovereign, he, of course, has no difficulty in deducing the validity of its edicts, which he calls positive law. But the problem is simply moved a step further back, and there left unsolved. The true question is, Whence the sovereignty? What is the assignable warrant for this unqualified supremacy assumed by one, or by a small number, or by a large number, over the rest? A critic might fitly say—"We will dispense with your process of deriving positive law from unlimited sovereignty: the sequence is obvious enough. But first prove your unlimited sovereignty."

To this demand there is no response. Analyze his assumption, and the doctrine of Austin proves to have no better basis than that of Hobbes. In the absence of admitted divine descent or appointment, neither single-headed ruler nor many-headed ruler can produce such credentials as the claim to unlimited sovereignty implies.

"But surely," will come in deafening chorus the reply, "there is the unquestionable right of the majority, which gives unquestionable right to the parliament it elects."

Yes, now we are coming down to the root of the matter. The divine right of Parliaments means the divine right of majorities. The fundamental assumption made by legislators and people alike is that a majority has powers to which no limits can be put. This is the current theory which all accept, without proof, as a self-evident truth. Nevertheless, criticism will, I think, show that this current theory requires a radical modification.

In an essay on "Railway Morals and Railway Policy," published in the "Edinburgh Review," for October, 1854, I had occasion to deal with the question of a majority's powers, as exemplified in the conduct of public companies; and I can not better prepare the way for conclusions presently to be drawn than by quoting some passages from it:

Under whatever circumstance, or for whatever ends, a number of men co-operate, it is held that if difference of opinion arises among them, justice requires that the will of the greater number shall be executed rather than that of the smaller number; and this rule is supposed to be uniformly applicable, be the question at issue what it may. So confirmed is this conviction, and so little have the ethics of the matter been considered, that to most this mere suggestion of a doubt will cause some astonishment. Yet it needs but a brief analysis to show that the opinion is little better than a political superstition. Instances may readily be selected, which prove, by *reductio ad absurdum*, that the right of a majority is a purely conditional right, valid only within specific limits. Let us take a few. Suppose that at the general meeting of some philanthropic association it was resolved that, in addition to relieving distress, the association should employ home missionaries to preach down popery. Might the subscriptions of Catholics, who had joined the body with charitable views, be rightfully used for this end? Suppose that of the members of a book-club the greater number, thinking that, under existing circumstances, rifle-practice was more important than reading, should decide to change the purpose of their union, and to apply the funds in hand for the purchase of powder, ball, and targets. Would the rest be bound by this decision? Suppose that, under the excitement of news from Australia, the majority of a Freehold Land Society should determine, not simply to start in a body for the gold-diggings, but to use their accumulated capital to provide outfits. Would this appropriation of property be just to the minority? and must these join the expedition? Scarcely any one would venture an affirmative answer even to the first of these questions, much less to the others. And why? Because every one must perceive that by uniting himself with others, no man can equitably be betrayed into acts utterly foreign to the purpose for which he joined them. Each of these supposed minorities would properly reply to those seeking to coerce them: "We combined with you for a defined object; we gave money and time for the furtherance of that object; on all questions thence arising we tacitly agreed to conform to the will of the greater number; but we did not agree to conform on any other questions. If you induce us to join you by professing a certain end, and then undertake some other end of which we were not apprised, you obtain our support under false pretenses: you exceed the expressed or understood compact to which we committed ourselves; and we are no longer bound by your decisions." Clearly this is the only rational interpretation of the matter. The general principle underlying the right government of every incorporated body is, that its members contract with each other severally to submit to the will of the majority in all matters concerning the fulfillment of the objects for which they are incorporated; but in no others. To this extent only can the contract hold. For as it is implied in the very nature of a contract that those entering into it must know what they contract to do, and as those who unite with others for a specified object can not contemplate all the unspecified objects which it is hypothetically possible for the union to undertake, it follows that the contract entered into can not extend to such unspecified objects; and if there exists no expressed or understood contract between the union and its members respecting unspecified objects, then for the majority to coerce the minority into undertaking them is nothing less than gross tyranny.

Naturally, if such a confusion of ideas exists in respect of the powers of a majority where the deed of incorporation tacitly limits those

powers, still more is there likely to exist such a confusion where there has been no such deed of incorporation. But the same principle holds. I again emphasize the proposition that the members of an incorporated body are bound "severally to submit to the will of the majority *in all matters concerning the fulfillment of the objects for which they are incorporated, but in no others.* And I contend that this holds of an incorporated nation as much as of an incorporated company.

"Yes, but," comes the obvious rejoinder, "as there is no deed by which the members of a nation are incorporated—as there neither is, nor ever was, a specification of purposes for which the union was formed, there exist no limits; and, consequently, the power of the majority is unlimited."

Evidently it must be admitted that the hypothesis of a social contract, either under the shape assumed by Hobbes, or under the shape assumed by Rousseau, is baseless. Nay, more, it must be admitted that even had such a contract once been formed, it could not be binding on the posterity of those who formed it. Moreover, if any say that in the absence of those limitations to its powers which a deed of incorporation might imply, there is nothing to prevent a majority from imposing its will on a minority by force, assent must be given—an assent, however, joined with the comment that if the superior force of the majority is its justification, then the superior force of a despot backed by an adequate army, is also justified: the problem lapses. What we here seek is some higher warrant for the subordination of minority to majority than that arising from inability to resist physical coercion. Even Austin, anxious as he is to establish the unquestionable authority of positive law, and assuming, as he does, an absolute sovereignty of some kind, monarchic, aristocratic, constitutional, or popular, as the source of its unquestionable authority, is obliged, in the last resort, to admit a moral limit to its action over the community. While insisting, in pursuance of his rigid theory of sovereignty, that a sovereign body originating from the people "is *legally* free to abridge their political liberty at its own pleasure or discretion," he allows that "a government may be hindered by *positive morality* from abridging the political liberty which it leaves or grants to its subjects."* Hence, we have to find, not a physical justification, but a moral justification, for the supposed absolute power of the majority.

This will at once draw forth the rejoinder, "Of course, in the absence of any agreement, with its implied limitations, the rule of the majority is unlimited; because it is more just that the majority should have its way than that the minority should have its way." A very reasonable rejoinder this seems until there comes the re-rejoinder. We may oppose to it the equally tenable proposition that, in the absence of an agreement, the supremacy of a majority over a minority does not exist at all. It is co-operation of some kind, from which there arise

* "The Province of Jurisprudence Determined" (second edition), p. 241.

these powers and obligations of majority and minority; and, in the absence of any agreement to co-operate, such powers and obligations are also absent.

Here the argument apparently ends in a dead-lock. Under the existing condition of things no moral origin seems assignable either for the sovereignty of the majority or for the limitation of its sovereignty. But further consideration reveals a solution of the difficulty. For if, dismissing all thought of any hypothetical agreement to co-operate heretofore made, we ask, what would be the agreement into which citizens would now enter with practical unanimity, we get a sufficiently clear answer; and with it a sufficiently clear justification for the rule of the majority inside a certain sphere, but not outside that sphere. Let us first observe a few of the limitations which at once become apparent.

Were all Englishmen now asked if they would agree to co-operate for the teaching of religion, and would give the majority power to fix the creed and the forms of worship, there would come a very emphatic "No" from a large part of them. If, in pursuance of a proposal to revive sumptuary laws, the inquiry were made whether they would bind themselves to abide by the will of the majority in respect of the fashions and qualities of their clothes, nearly all of them would refuse. In like manner, if (to take an actual question of the day) people were polled to ascertain whether, in respect of the beverages they drank, they would accept the decision of the greater number, half, and probably more than half, would very decidedly decline. Similarly with respect to many other actions which most men now-a-days regard as of purely private concern. Whatever desire there might be to co-operate for carrying on, or regulating, such actions, would be far from a unanimous desire. Manifestly, then, had social co-operation to be commenced by ourselves, and had its purposes to be specified before consent to co-operate could be obtained, there would be large parts of human conduct in respect of which co-operation would be declined; and in respect of which, consequently, no authority by the majority over the minority could be rightfully exercised.

Turn now to the converse question, For what ends would all men agree to co-operate? None will deny that for resisting invasion the agreement would be practically unanimous. Excepting only the Quakers, who, having done highly useful work in their time, are now dying out, all would unite for defensive war (not, however, for offensive war); and they would, by so doing, tacitly bind themselves to conform to the will of the majority in respect of measures directed to that end. There would be practical unanimity, also, in the agreement to co-operate for defense against internal enemies as against external enemies. Omitting criminals, all must wish to have person and property adequately protected. In short, each citizen desires to preserve his life, to preserve those material things which conduce to mainte-

nance of his life, and to preserve intact his powers both of using these material things and getting further such. It is obvious to him that he can not do this if he acts alone. Against foreign invaders he is powerless unless he combines with his fellows; and the business of protecting himself against domestic invaders if he did not similarly combine, would be alike onerous, dangerous, and inefficient. That is to say, in respect of all measures for maintaining those conditions under which only the business of life can be carried on and its satisfactions obtained, every one will agree to co-operate; and, by implication, will agree to submit to the majority on all questions thence arising.

Details are not needful here; nor is it needful to discuss that border region lying between these classes of cases, and to say how much is included in the last and how much is excluded with the first. For the present purpose, it is sufficient to recognize the undeniable truth that there are numerous kinds of actions in respect of which men would not, if they were asked, agree with anything like unanimity to be bound by the will of the majority; while there are some kinds of actions in respect of which they would almost unanimously agree to be thus bound. Here, then, we find a definite warrant for enforcing the will of the majority within certain limits, and a definite warrant for denying the authority of its will beyond those limits.

But evidently, when analyzed, the question resolves itself into the further question, What are the relative claims of the aggregate and of its units? Are the rights of the community universally valid against the individual? or has the individual some rights which are valid against the community? The judgment given on this point underlies the entire fabric of political convictions formed, and more especially those convictions which concern the proper sphere of government. Here, then, I propose to revive a dormant controversy, with the expectation of reaching a different conclusion from that which is fashionable.

Says Professor Jevons, in his work, "The State in Relation to Labor"—"The first step must be to rid our minds of the idea that there are any such things in social matters as abstract rights." Of like character is the belief expressed by Mr. Matthew Arnold, in his article on copyright: "An author has no natural right to a property in his production. But then neither has he a natural right to anything whatever which he may produce or acquire."* So, too, I recently read in a weekly journal of high repute, that "to explain once more that there is no such thing as 'natural right' would be a waste of philosophy." And the view expressed in these extracts is commonly uttered by statesmen and lawyers in a way implying that only the unthinking masses hold any other.

* "Fortnightly Review," in 1880, vol. xxvii, p. 322.

One might have expected that utterances to this effect would have been rendered less dogmatic by the knowledge that a whole school of legists on the Continent maintains a belief diametrically opposed to that maintained by the English school. The idea of *Natur-recht* is the root-idea of German jurisprudence. Now, whatever may be the opinion held respecting German philosophy at large, it can not be characterized as shallow. A doctrine current among a people distinguished above all others as laborious inquirers, and certainly not to be classed with superficial thinkers, should not be dismissed as though it were nothing more than a popular delusion. This, however, by the way. Along with the proposition denied in the above quotations, there goes a counter-proposition affirmed. Let us see what it is, and what results when we go behind it and seek its warrant.

On reverting to Bentham, we find this counter-proposition overtly expressed. He tells us that government fulfills its office "by creating rights, which it confers upon individuals—rights of personal security; rights of protection for honor; rights of property"; etc.* Were this doctrine asserted as following from the divine right of kings, there would be nothing in it manifestly incongruous. Did it come to us from ancient Peru, where the Inca "was the source from which everything flowed";† or from Shoa (Abyssinia), where "of their persons and worldly substance he [the king] is absolute master";‡ or from Dahome, where "all men are slaves to the king";§ it would be consistent enough. But Bentham, far from being an absolutist like Hobbes, wrote in the interests of popular rule. In his "Constitutional Code"‖ he fixes the sovereignty in the whole people: arguing that it is best to "give the sovereign power to the largest possible portion of those whose greatest happiness is the proper and chosen object," because "this proportion is more apt than any other that can be proposed" for achievement of that object.

Mark, now, what happens when we put these two doctrines together. The sovereign people is to appoint representatives, and so to create a government; the government thus created, creates rights; and then, having created these rights, it confers them on the sovereign people by which it was itself created. Here is a marvelous piece of political iegerdemain! Mr. Matthew Arnold, contending, in the article above quoted, that "property is the creation of law," tells us to beware of the "metaphysical phantom of property in itself." Surely, among metaphysical phantoms the most shadowy is this which supposes a thing to be obtained by creating an agent, which creates the thing, and then confers the thing on its own creator!

* Bentham's Works (Bowring's edition), vol. i, p. 301.
† Prescott, "Conquest of Peru," book i, ch. i.
‡ Harris, "Highlands of Æthiopia," ii, 94.
§ Burton, "Mission to Gelele, King of Dahomie," i, p. 226.
‖ Bentham's Works, vol. ix, p. 97.

From whatever point of view we consider it, Bentham's proposition proves to be unthinkable. Government, he says, fulfills its office "by creating rights." Two meanings may be given to the word "creating." It may be supposed to mean the production of something out of nothing; or it may be supposed to mean the giving form and structure to something which already exists. There are many who think the production of something out of nothing can not be conceived as effected even by Omnipotence; and probably none will assert that the production of something out of nothing is within the competence of a human government. The alternative conception is that such human government creates only in the sense that it shapes something pre-existing. In that case, the question arises, "What is the something pre-existing which it shapes?" Clearly the word "creating" begs the whole question—passes off an illusion upon the unwary reader. Bentham was a stickler for definiteness of expression, and in his "Book of Fallacies" has a chapter on "Impostor-terms." It is curious that he should have furnished so striking an illustration of the perverted belief which an impostor-term may generate.

But now let us overlook these various impossibilities of thought, and seek the most defensible interpretation of Bentham's view.

It may be said that the totality of all possessions, powers, rights, originally existed as an undivided whole in the sovereign people; and that this undivided whole is given in trust (as Austin would say) to a ruling power, appointed by the sovereign people, for the purpose of distribution. If, as we have seen, the proposition that rights are created is simply a figure of speech, then the only intelligible construction of Bentham's view is that a multitude of individuals, who severally wish to satisfy their desires, and have, as an aggregate, possession of all the sources of satisfaction, as well as power over all individual actions, appoint a government, which declares the ways in which, and the conditions under which, individual actions may be carried on and the satisfactions obtained. Let us observe what are the implications. Each man exists in two capacities. In his private capacity he is subject to the government. In his public capacity he is one of the sovereign people who appoint the government. That is to say, in his private capacity he is one of those to whom rights are given; and in his public capacity he is one of those who, through their agency, give the rights. Turn this abstract statement into a concrete statement, and see what it means. Let the community consist of a million men, who, by the hypothesis, are not only joint possessors of the inhabited region, but joint possessors of all liberties of action and appropriation: the only right recognized being that of the aggregate to everything. What follows? Each person, while not owning any product of his own labor, has, as a unit in the sovereign body, a millionth part of the ownership of the products of all others' labor. This is an unavoidable implication. No body of men can confer that which it has not

got. As the government, in Bentham's view, is but an agent, the rights it confers are rights given to it in trust by the sovereign people. If so, such rights must be possessed *en bloc* by the sovereign people before the government, in fulfillment of its trust, confers them on individuals; and, if so, each individual has a millionth portion of these rights in his public capacity, while he has no rights in his private capacity. These he gets only when all the rest of the million join to endow him with them; while he joins to endow with them every other member of the million!

Thus, in whatever way we interpret it, Bentham's proposition leaves us in a plexus of absurdities.

Even though ignoring the opposite opinion of the German writers on jurisprudence, and even without an analysis which proves their own opinion to be untenable, Bentham's disciples might have been led to treat less cavalierly the doctrine of natural rights. For sundry groups of social phenomena unite to prove that this doctrine is well warranted, and the doctrine they set against it entirely unwarranted.

Tribes in various parts of the world show us that before definite government arises, conduct is regulated by customs. The Bechuanas are controlled by "long-acknowledged customs."* Among the Koranna Hottentots, who only "tolerate their chiefs rather than obey them,"† "when ancient usages are not in the way, every man seems to act as is right in his own eyes."‡ The Araucanians are guided by "nothing more than primordial usages or tacit conventions."* Among the Kirghizes the judgments of the elders are based on "universally-recognized customs."‖ So, too, of the Dyaks, Rajah Brooke tells us that "custom seems simply to have become the law; and breaking custom leads to a fine."△ So sacred are immemorial customs with the primitive man, that he never dreams of questioning their authority; and when government arises, its power is limited by them. In Madagascar the king's word suffices only "where there is no law, custom, or precedent."◊ Raffles tells us that in Java "the customs of the country"‡ restrain the will of the ruler. In Sumatra, too, the people do not allow their chiefs to "alter their ancient usages."‡ Nay, occasionally, as in Ashantee, "the atttempt to change some customs" has caused a king's dethronement.‡ Now, among the customs which we

* Burchell, W. J., "Travels into the Interior of Southern Africa," vol. i, p. 544.

† Arbousset and Daumas, "Voyage of Exploration," p. 27.

‡ Thompson, G., "Travels and Adventures in Southern Africa," vol. ii, p. 30.

* Thompson, G. A., "Alcedo's Geographical and Historical Dictionary of America," vol. i, p. 405.

‖ Mitchell, Alex., "Siberian Overland Route," p. 248.

△ Brooke's, C., "Ten Years in Saráwak," vol. i, p. 129.

◊ Ellis, "History of Madagascar," vol. i, p. 377.

‡ Raffles, Sir T. S., "History of Java," i, 274.

‡ Marsden, W., "History of Sumatra," p. 217.

‡ Beecham, J., "Ashantee and the Gold Coast," p. 90.

thus find to be pre-governmental, and which subordinate governmental power when it is established, are those which recognize certain individual rights—rights to act in certain ways, and possess certain things. Even where the recognition of property is least developed, there is proprietorship of weapons, tools, and personal ornaments; and, generally, the recognition goes far beyond this. Among such North-American Indians as the Snakes, who are without government, there is private ownership of horses. By the Chippewayans, who have no regular government," game taken in private traps "is considered as private property."* Kindred facts concerning huts, utensils, and other personal belongings, might be brought in evidence from accounts of the Ahts, the Comanches, the Esquimaux, and the Brazilian Indians. Among various uncivilized peoples, custom has established the claim to the crop grown on a cleared plot of land, though not to the land itself; and the Todas, who are wholly without political organization, make a like distinction between ownership of cattle and of land. Kolff's statement respecting "the peaceful Arafuras" well sums up the evidence. They "recognize the right of property in the fullest sense of the word, without there being any authority among them but the decisions of their elders according to the customs of their forefathers."† But even without seeking proofs among the uncivilized, sufficient proofs are furnished by early stages of the civilized. Bentham and his followers seem to have forgotten that our own common law is mainly an embodiment of "the customs of the realm." It did but give definite shape to that which it found existing. Thus, the fact and the fiction are exactly opposite to what they allege. The fact is that property was well recognized before law existed; the fiction is that "property is the creation of law."

Considerations of another class might alone have led them to pause had they duly considered their meanings. Were it true, as alleged by Bentham, that Government fulfills its office "by creating rights which it confers on individuals"; then, the implication would be that there should be nothing approaching to uniformity in the rights conferred by different governments. In the absence of a determining cause overruling their decisions, the probabilities would be many to one against considerable correspondence among their decisions. But there is very great correspondence. Look where we may, we find that governments interdict the same kinds of aggressions; and, by implication, recognize the same kinds of claims. They habitually forbid homicide, theft, adultery: thus asserting that citizens may not be trespassed against in certain ways. And as society advances, minor individual claims are protected by giving remedies for breach of contract, libel, false witness, etc. In a word, comparisons show that though codes of law differ in their details as they become elaborated, they agree in

* Schoolcraft, H. R., "Expedition to the Sources of the Mississippi River," v, 177.

† Earl's "Kolff's Voyage of the Domga," p. 161.

their fundamentals. What does this prove? It can not be by chance that they thus agree. They agree because the alleged creating of rights was nothing else than giving formal sanction and better definition to those assertions of claims and recognitions of claims which naturally originate from the individual desires of men who have to live in presence of one another.

Comparative sociology discloses another group of facts having the same implication. Along with social progress it becomes in an increasing degree the business of the State, not only to give formal sanction to men's rights, but also to defend them against aggressors. Before permanent government exists, and in many cases after it is considerably developed, the rights of each individual are asserted and maintained by himself, or by his family. Alike among savage tribes at present, among civilized peoples in the past, and even now in unsettled parts of Europe, the punishment for murder is a matter of private concern: "the sacred duty of blood revenge" devolves on some one of a cluster of relatives. Similarly, compensations for aggressions on property, and for injuries of other kinds, are in early states of society obtained by each man for himself. But as social organization advances, the central ruling power undertakes more and more to secure to individuals their personal safety, the safety of their possessions, and, to some extent, the enforcement of their claims established by contract. Originally concerned almost exclusively with defense of the society as a whole against other societies, or with conducting its attacks on other societies, Government has come more and more to discharge the function of defending individuals against one another. It needs but to recall the days when men habitually carried weapons, or to bear in mind the greater safety to person and property achieved by improved police-administration during our own time, or to note the increased facilities now given for recovering small debts, to see that the securing to each individual the unhindered pursuit of the objects of life within limits set by others' like pursuits, is more and more recognized as a duty of the State. In other words, along with social progress there goes not only a fuller recognition of these which we call natural rights, but also a better enforcement of them by Government: Government becomes more and more the servant to these essential requirements.

An allied and still more significant change has accompanied this. In early stages, at the same time that the State failed to protect the individual against aggression, it was itself an aggressor in multitudinous ways. Those ancient societies which progressed enough to leave records, having all been conquering societies, show us everywhere the traits of the militant *régime*. As, for the effectual organization of fighting bodies, the soldiers, absolutely obedient, must show no personal independence; so, for the effectual organization of fighting societies, citizens must have their individualities subordinated. Private

claims are overridden by public claims, and the subject loses that freedom of action which he had in the primitive state. One result is that the system of regimentation pervading the society as well as the army causes detailed regulation of conduct. The dictates of the ruler, sanctified by ascription of them to his divine ancestor, are unrestrained by any conception of individual liberty; and they specify men's actions to an unlimited extent—down to kinds of food eaten, modes of preparing them, shaping of beards, fringing of dresses, sowing of grain, etc. The omnipresent control, which the ancient eastern nations in general exhibited, was exhibited also in large measure by the Greeks; and was carried to its greatest pitch in the most militant city, Sparta. Similarly during mediæval days throughout Europe, characterized by chronic warfare with its appropriate political forms and ideas, there were no recognized bounds to Governmental interference: agriculture, manufacture, trade, were regulated in detail; religious beliefs and observances were imposed; and rulers said by whom only furs might be worn, silver used, books issued, pigeons kept, etc., etc. But along with increase of industrial activities, and implied substitution of the *régime* of contract for the *régime* of status, and growth of associated sentiments, there went (until the recent reaction accompanying reversion to militant activity) a decrease of meddling with people's doings. Legislation gradually ceased to regulate the cropping of fields, or dictate the ratio of cattle to acreage, or specify modes of manufacture and materials to be used, or fix wages and prices, or interfere with dresses and games (except where there was gambling), or put bounties and penalties on imports or exports, or prescribe men's beliefs, religious or political, or prevent them from combining as they pleased, or traveling where they liked. That is to say, throughout a large range of conduct, the right of the citizen to uncontrolled action has been made good against the pretensions of the State to control him. While the ruling agency has increasingly helped him to exclude intruders from that private sphere in which he pursues the objects of life, it has itself retreated from that sphere; or, in other words—decreased its intrusions.

Not even yet have we noted all the classes of facts which tell the same story. It is told afresh in the improvements and reforms of law itself, as well as in the admissions and assertions of those who have effected them. "So early as the fifteenth century," says Professor Pollock, "we find a common-law judge declaring that, as in a case unprovided for by known rules, the civilians and canonists devise a new rule according to 'the law of nature, which is the ground of all laws,' the Courts of Westminster can and will do the like."* Again, our system of equity, introduced and developed as it was to make up for the shortcomings of Common-law, or rectify its inequities, proceeded

* "The Methods of Jurisprudence: an Introductory Lecture at University College, London," October 31, 1882.

throughout on a recognition of men's claims considered as existing apart from legal warrant. And the changes of law now from time to time made after resistance, are similarly made in pursuance of current ideas concerning the requirements of justice; which, instead of being derived from the law are opposed to the law. For example, that recent Act which gives to a married woman a right of property in her own earnings, evidently originated in the consciousness that the natural connection between labor expended and benefit enjoyed, is one which should be maintained in all cases. The reformed law did not create the right, but recognition of the right created the reformed law.

Thus, historical evidences of five different kinds, unite in teaching that, confused as are the popular notions concerning rights, and including, as they do, much which should be excluded, yet they shadow forth a truth.

Let us now go on to consider the original source of this truth. In a previous paper I have spoken of the open secret, that there can be no social phenomena but what, if we analyze them to the bottom, bring us down to the laws of life; and that there can be no true understanding of them without reference to the laws of life. Let us now change the venue, and transfer this question of natural rights from the court of politics to the court of science—the science of life. The reader need feel no alarm; its simplest and most obvious facts will suffice. Let us contemplate first the general conditions to individual life; and then the general conditions to social life. We shall find that both yield the same verdict.

Animal life involves waste; waste must be met by repair; repair implies nutrition. Again, nutrition presupposes obtainment of food; food can not be got without powers of prehension, and, usually, of locomotion; and that these powers may achieve their ends, there must be freedom to move about. If you shut up a mammal in a small space, or tie its limbs together, or take from it the food it has procured, you eventually, by persistence in one or other of these courses, cause its death. Passing a certain point, hindrance to the fulfillment of these requirements is fatal. And all this, which holds of the higher animals at large, of course holds of man.

If we adopt pessimism as a creed, and with it accept the implication that life in general being an evil should be put an end to, then there is no ethical warrant for these actions by which life is maintained: the whole question drops. But if we adopt either the optimist view or the meliorist view—if we say that life on the whole brings more pleasure than pain; or that it is on the way to become such that it will yield more pleasure than pain; then these actions by which life is maintained are justified, and there results a warrant for the freedom to perform them. Those who hold that life is valuable, hold, by implication, that men ought not to be prevented from carrying on life-sustaining activi-

ties. In other words, if it is said to be "right" that they should carry them on, then, by permutation, we get the assertion that they "have a right" to carry them on. Clearly the conception of "natural rights" originates in recognition of the truth that if life is justifiable, there must be a justification for the performance of acts essential to its preservation; and, therefore, a justification for those liberties and claims which make these acts possible.

But being true of other creatures as of man, this is a proposition lacking ethical character. Ethical character arises only with the distinction between what the individual *may* do in carrying on his life-sustaining activities, and what he *may not* do. This distinction obviously results from the presence of his fellows. Among those who are in close proximity, or even at some distance apart, the doings of each are apt to interfere with the doings of others, and in the absence of proof that some may do what they will without limit, while others may not, mutual limitation is necessitated. The non-ethical form of the right to pursue ends, passes into the ethical form when there is recognized the difference between acts which can be performed without transgressing the limits, and others which can not be so performed.

This, which is the *a priori* conclusion, is the conclusion yielded *a posteriori*, when we study the doings of the uncivilized. In its vaguest form, mutual limitation of spheres of action, and the ideas and sentiments associated with it, are seen in the relations of groups to one another. Habitually there come to be established certain bounds to the territories within which each tribe obtains its livelihood; and these bounds when not respected are defended. Among the Wood-Veddahs, who have no political organization, the small clans have their respective portions of forest; and "these conventional allotments are always honorably recognized."* Of the ungoverned tribes of Tasmania, we are told that "their hunting-grounds were all determined, and trespassers were liable to attack."† And, manifestly, the quarrels caused among tribes by intrusions on one another's territories, tend in the long run to fix bounds and to give a certain sanction to them. As with each inhabited area, so with each inhabiting group. A death in one, rightly or wrongly ascribed to somebody in another, prompts "the sacred duty of blood-revenge"; and though retaliations are thus made chronic, some restraint is put on new aggressions. Like causes and effects were seen in those early stages of civilized societies, during which families or clans, rather than individuals, were the political units; and during which each family or clan had to maintain itself and its possessions against others such. This mutual restraint, which in the nature of things arises between small communities, similarly arises between individuals in each community; and the ideas and usages appropriate to the one are more or less appropriate to the other. Though within each group there is ever

* Tennant, ii, 440. † Bonwick, J., "Daily Life and Origin of the Tasmanians," 83.

a tendency for the stronger to aggress on the weaker; yet, generally, consciousness of the evils resulting from aggressive conduct serves to restrain. Everywhere among primitive peoples, trespasses are followed by counter-trespasses. Says Turner, of the Tannese, "Adultery and some other crimes are kept in check by the fear of club-law." * Fitzroy tells us that the Patagonian, "if he does not injure or offend his neighbor, is not interfered with by others": † personal vengeance being the penalty for injury. We read of the Uaupés that "they have very little law of any kind; but what they have is of strict retaliation—an eye for an eye and a tooth for a tooth." ‡ And that the *lex talionis* tends to establish a distinction between what each member of the community may safely do and what he may not safely do, and consequently to give a sanction to actions within a certain range but not beyond that range, is obvious. Though, says Schoolcraft of the Chippewayans, they "have no regular government, as every man is lord in his own family, they are influenced more or less by certain principles which conduce to their general benefit": * one of the principles named being recognition of private property.

How mutual limitation of activities originates the ideas and sentiments implied by the phrase "natural rights," we are shown most distinctly by the few peaceful tribes which have either nominal governments or none at all. Beyond those facts which illustrate scrupulous regard for one another's claims among the Todas, Santals, Lepchas, Bodo, Chakmas, Jakuns, Arafuras, etc., we have the fact that the utterly-uncivilized Wood-Veddahs, without any social organization at all, "think it perfectly inconceivable that any person should ever take that which does not belong to him, or strike his fellow, or say anything that is untrue." ‖ Thus it becomes clear, alike theoretically and historically, that while the positive element in the right to carry on life-sustaining activities originates from the laws of life, that negative element which gives ethical character to it, originates from the conditions produced by social aggregation.

So alien to the truth, indeed, is the alleged creation of rights by government, that, contrariwise, rights having been established more or less clearly before government arises, become obscured as government develops, along with that militant activity which, both by the taking of slaves and the establishment of ranks, produces *status;* and the recognition of rights begins again to get definiteness only as fast as militancy ceases to be chronic and governmental power declines.

When we turn from the life of the individual to the life of the society, the same lesson is taught us.

* "Polynesia," p. 86. † "Voyages of the Adventure and Beagle," ii, 167.

‡ Wallace, A. R., "Travels on Amazon and Rio Negro," p. 499.

* Schoolcraft, "Expedition to the Sources of the Mississippi," v, 177.

‖ B. F., Hartshorne, "Fortnightly Review," March, 1876. See also H. C. Sirr, "Ceylon and the Ceylonese," ii, 219.

Though mere love of companionship prompts primitive men to live in groups, yet the chief prompter is experience of the advantages to be derived from co-operation. On what condition only can co-operation arise? Evidently on condition that those who join their efforts severally gain by doing so. If, as in the simplest cases, they unite to achieve something which each by himself can not achieve, or can achieve less readily, it must be on the tacit understanding, either that they shall share the benefit (as when game is caught by a party of them) or that if one reaps all the benefit now (as in building a hut or clearing a plot) the others shall severally reap equivalent benefits in their turns. When instead of efforts joined in doing the same thing different things are effected by them—when division of labor arises, with accompanying barter of products, the arrangement implies that each in return for something which he has in superfluous quantity, gets an approximate equivalent of something which he wants. If he hands over the one and does not get the other, future proposals to exchange will meet with no response. There will be a reversion to that rudest condition in which each makes everything for himself. Hence the possibility of co-operation depends on fulfillment of contract, tacit or overt.

Now this which we see must hold of the very first step toward that industrial organization by which the life of a society is maintained, must hold more or less fully throughout its development. Though the militant type of organization, with its system of *status* produced by chronic war, greatly obscures these relations of contract, yet they remain partially in force. They still hold between freemen, and between the heads of those small groups, which form the units of early societies; and in a measure they still hold within these small groups themselves; since survival of them as groups, implies such recognition of the claims of their members, even when slaves, that in return for their labors they get sufficiencies of food, clothing, and protection. And when, with diminution of warfare and growth of trade, voluntary co-operation more and more replaces compulsory co-operation, and the carrying on of social life by exchange under agreement, partially suspended for a time, gradually re-establishes itself; its re-establishment brings the possibility of that vast elaborate industrial organization by which a great nation is sustained.

For in proportion as contracts are unhindered and the performance of them certain, the growth is great and the social life active. It is not now by one or other of two individuals who contract, that the evil effects of breach of contract are experienced. In an advanced society, they are experienced by entire classes of producers and distributors which have arisen through division of labor; and eventually they are experienced by everybody. Ask on what condition it is that Birmingham devotes itself to manufacturing hardware, or part of Staffordshire to making pottery, or Lancashire to weaving cotton? Ask how the

rural people who here grow wheat and there pasture cattle, find it possible to occupy themselves in their special businesses? These groups can severally do it only if each gets from the others in exchange for its own surplus product, due shares of their surplus products. No longer directly effected by barter, this obtainment of their respective shares of one another's products is indirectly effected by money; and if we ask how each division of producers gets its due amount of the required money, the answer is—by fulfillment of contract. If Leeds makes woolens and does not, by fulfillment of contract, receive the means of obtaining from agricultural districts the needful quantity of food, it must starve, and stop producing woolens. If South Wales smelts iron and there comes no equivalent agreed upon, enabling it to get fabrics for clothing, its industry must cease. And so throughout, in general and in detail. That mutual dependence of parts which we see in social organization, as in individual organization, is possible only on condition that while each part does the particular kind of work it has become adjusted to, it receives its proportion of those materials required for repair and growth, which all the other parts have joined to produce: such proportion being settled by bargaining. Moreover, it is by fulfillment of contract that there is effected a balancing of all the various products of the various needs—the large manufacture of knives and the small manufacture of lancets; the great growth of wheat and the small growth of mustard-seed. The check on undue production of each commodity results from finding that after a certain quantity, no one will agree to take any further quantity on terms that yield an adequate money equivalent. And so there is prevented a useless expenditure of labor in producing that which society does not want.

Lastly, we have to note the still more significant fact that the condition under which only, any specialized group of workers can grow when the community needs more of its particular kind of work, is that contracts shall be free and fulfillment of them enforced. If when, from lack of material, Lancashire failed to supply the usual amount of cotton-goods, there had been such interference with contracts as prevented Yorkshire from asking a greater price for its woolens, which it was enabled to do by the greater demand for them, there would have been no temptation to put more capital into the woolen manufacture, no increase in the amount of machinery and number of artisans employed, and no increase of woolens: the consequence being that the whole community would have suffered from not having deficient cottons replaced by extra woolens. What serious injury may result to a nation if its members are hindered from contracting with one another, was well shown in the contrast between England and France in respect of railways. Here, though considerable obstacles were at first raised by the legislating classes, the obstacles were not such as prevented capitalists from investing, engineers from furnishing directive skill, or con-

tractors from undertaking works; and the high interest originally obtained on investments, the great profits made by contractors, and the large payments received by engineers, led to that drafting of money, energy, and ability, into railway-making, which rapidly developed our railway-system, to the enormous increase of our national prosperity. But when M. Thiers, then Minister of Public Works, came over to inspect, and having been taken about by Mr. Vignoles, said to him when leaving:—"I do not think railways are suited to France,"* there resulted from the consequent policy of hindering free contract, a delay of "eight or ten years" in that material progress which France experienced when railways were made.

What do all these facts mean? They mean that for the healthful activity and due proportioning of those various industries, professions, etc. which maintain and aid the life of a society, there must, in the first place, be no restrictions on men's liberties to make agreements with one another, and there must, in the second place, be an enforcement of the agreements which they do make. As we have seen, the checks naturally arising to each man's actions when men become associated, are those only which result from mutual limitation; and there consequently can be no resulting check to the contracts they voluntarily make: interference with these is interference with those rights to free action which remain to each when the rights of others are fully recognized. And then, as we have seen, enforcement of their rights implies enforcement of contracts made; since breach of contract is indirect aggression. If, when a customer on one side of the counter asks a shopkeeper on the other for a shilling's worth of his goods, and, while the shopkeeper's back is turned, walks off with the goods without leaving the shilling he tacitly contracted to give, the case differs in no essential way from robbery. Similarly, if analyzed, every breach of contract proves to be a case in which the individual injured is deprived of something he possessed, without receiving the equivalent something bargained for; and is in the condition of having expended his labor without getting benefit—has had an essential condition to the maintenance of life infringed.

Thus, then, it results that to recognize and enforce the rights of individuals, is at the same time to recognize and enforce the conditions to a normal social life. There is one vital requirement for both.

Before turning to those corollaries which have practical applications, let us observe how the special conclusions drawn converge to the one general conclusion originally foreshadowed—glancing at them in reversed order.

We have just found that the prerequisite to individual life is in a double sense the prerequisite to social life. The life of a society in

* "Address of C. B. Vignoles, Esq., F. R. S., on his Election as President of the Institution of Civil Engineers, Session 1869–'70," p. 53.

whichever of two senses conceived, depends on maintenance of individual rights. If it is nothing more than the sum of the lives of citizens, this implication is obvious. If it consists of those many unlike activities which citizens carry on in mutual dependence, still this aggregate impersonal life rises or falls according as the rights of individuals are enforced or denied.

Study of men's politico-ethical ideas and sentiment, leads to allied conclusions. Primitive peoples of various types show us that before governments exist, immemorial customs recognize private claims and justify maintenance of them. Codes of law independently evolved by different nations, agree in forbidding certain trespasses on the persons, properties, and liberties of citizens; and their correspondences imply, not an artificial source for individual rights, but a natural source. Along with social development, the formulating in law of the rights pre-established by custom, becomes more definite and elaborate. At the same time, Government undertakes to an increasing extent the business of enforcing them. While it has been becoming a better protector, Government has been becoming less aggressive—has more and more diminished its intrusions on men's spheres of private action. And, lastly, as in past times laws were avowedly modified to fit better with current ideas of equity, so now, law-reformers are guided by ideas of equity which are not derived from law but to which law has to conform.

Here, then, we have a politico-ethical theory justified alike by analysis and by history. What have we against it? A fashionable counter-theory which proves to be unjustifiable. On the one hand, while we find that individual life and social life both imply maintenance of the natural relation between efforts and benefits; we also find that this natural relation, recognized before Government existed, has been all along asserting and reasserting itself, and obtaining better recognition in codes of law and systems of ethics. On the other hand, those who, denying natural rights, commit themselves to the assertion that rights are artificially created by law, are not only flatly contradicted by facts, but their assertion is self-destructive: the endeavor to substantiate it, when challenged, involves them in manifold absurdities.

Nor is this all. The reinstitution of a vague, popular conception in a definite form on a scientific basis, leads us to a rational view of the relation between the wills of majorities and minorities. It turns out that those co-operations in which all can voluntarily unite, and in the carrying on of which the will of the majority is rightly supreme, are co-operations for maintaining the conditions requisite to individual and social life. Defense of the society as a whole against external invaders, has for its remote end to preserve each citizen in possession of such means as he has for satisfying his desires, and in possession of such liberty as he has for getting further means. And

defense of each citizen against internal invaders, from murderers down to those who inflict nuisances on their neighbors, has obviously the like end—an end desired by every one save the criminal and disorderly. Hence it follows that for maintenance of this vital principle, alike of individual life and social life, subordination of minority by majority is legitimate; as implying only such a trenching on the freedom and property of each, as is requisite for the better protecting of his freedom and property. At the same time it follows that such subordination is not legitimate beyond this; since, implying as it does a greater aggression upon the individual than is requisite for protecting him, it involves a breach of the vital principle which is to be maintained.

Thus we come round again to the proposition that the assumed divine right of parliaments, and the implied divine right of majorities, are superstitions. While men have abandoned the old theory respecting the source of State-authority, they have retained a belief in that unlimited extent of State-authority which rightly accompanied the old theory, but does not rightly accompany the new one. Unrestricted power over subjects, rationally ascribed to the ruling man when he was held to be a deputy-god, is now ascribed to the ruling body, the deputy-godhood of which nobody asserts.

Opponents will, possibly, contend that discussions about the origin and limits of governmental authority are mere pedantries. "Government," they may perhaps say, "is bound to use all the means it has, or can get, for furthering the general happiness. Its aim must be utility; and it is warranted in employing whatever measures are needful for achieving useful ends. The welfare of the people is the supreme law; and legislators are not to be deterred from obeying that law by questions concerning the source and range of their power." Is there really an escape here? or may the opening be effectually closed?

The essential question raised is the truth of the utilitarian theory as commonly held; and the answer here to be given is that, as commonly held, it is not true. Alike by the statements of utilitarian moralists, and by the acts of politicians knowingly or unknowingly following their lead, it is implied that utility is to be directly determined by simple inspection of the immediate facts and estimation of probable results. Whereas, utilitarianism as rightly understood, implies guidance by the general conclusions which analysis of experience yields. "Good and bad results can not be accidental, but must be necessary consequences of the constitution of things"; and it is "the business of Moral Science to deduce, from the laws of life and the conditions of existence, what kinds of action necessarily tend to produce happiness, and what kinds to produce unhappiness."* Current utilitarian speculation, like current practical politics, shows inadequate consciousness of natural causation. The habitual thought is that, in the absence of

* "Data of Ethics," § 21, and §§ 56–62.

some obvious impediment, things can be done this way or that way; and no question is put whether there is either agreement or conflict with the normal working of things.

The foregoing discussions have, I think, shown that the dictates of utility, and, consequently, the proper actions of governments, are not to be settled by inspection of facts on the surface, and acceptance of their *prima facie* meanings; but are to be settled by reference to, and deduction from, fundamental facts. The fundamental facts to which all rational judgments of utility must go back, are the facts that life consists in, and is maintained by, certain activities; and that among men in a society, these activities, necessarily becoming mutually limited, are to be carried on by each within the limits thence arising, and not carried on beyond those limits: the maintenance of the limits becoming, by consequence, the function of the agency which regulates society. If each, having freedom to use his powers up to the bounds fixed by the like freedom of others, obtains from his fellow-men as much for his services as they find them worth in comparison with the services of others—if contracts uniformly fulfilled bring to each the share thus determined, and he is left secure in person and possessions to satisfy his wants with the proceeds; then there is maintained the vital principle alike of individual life and of social life. Further, there is maintained the vital principle of social progress; inasmuch as under such conditions, the individuals of more worth will prosper and multiply more than those of less worth. So that utility, not as empirically estimated, but as rationally determined, enjoins this maintenance of individual rights; and, by implication, negatives any course which traverses them.

Here, then, we reach the ultimate interdict against meddling legislation. Reduced to its lowest terms, every proposal to interfere with citizens' activities further than by enforcing their mutual limitations, is a proposal to improve life by breaking through the fundamental conditions to life. When some are prevented from buying beer that others may be prevented from getting drunk, those who make the law assume that more good than evil will result from interference with the normal relation between conduct and consequences, alike in the few ill-regulated and the many well-regulated. A government which takes fractions of the incomes of multitudinous citizens for the purpose of sending to the colonies some who have not prospered here, or for building better industrial dwellings, or for making public libraries and public museums, etc., etc., takes for granted that, not only proximately but ultimately, increased general happiness will result from transgressing the essential requirement to general happiness—the requirement that each shall enjoy all those means to happiness which his actions, carried on without aggression on others, have brought him. In other cases we do not thus let the immediate blind us to the remote. We do not when asserting the sacredness of property against private

aggressors, ask whether the benefit to the hungry man who takes bread from a baker's shop, is or is not greater than the injury inflicted on the baker: we consider not the special effects but the general effects which arise if property is insecure. But when the State exacts further amounts from individuals, or further restrains their liberties, we consider only the direct and proximate effects, and ignore the indirect and distant effects which arise when these invasions of individual rights are continually multiplied. We do not see that by accumulated small infractions of them, the vital conditions to life, individual and social, come to be so little fulfilled that the life decays.

Yet the decay thus caused becomes manifest where the policy is pushed to an extreme. Any one who studies, in the writings of MM. Taine and De Tocqueville, the state of things which preceded the French Revolution, will see that that tremendous catastrophe came about from so excessive a regulation of men's actions in all their details, and such an enormous drafting away of the products of their actions to maintain the regulating organization, that life was fast becoming impracticable. The empirical utilitarianism of that day, like the empirical utilitarianism of our day, differed from the rational utilitarianism in this, that it contemplated only the effects of particular interferences on the actions of particular classes of men, and ignored the effects produced by a multiplicity of such interferences upon the lives of men at large. And if we ask what then made, and what now makes, this error possible, we find it to be the political superstition that governmental power is subject to no restraints.

When that "divinity" which "doth hedge a king," and which in our day has left a glamour around the body inheriting his power, has quite faded away—when it begins to be seen clearly that, in a popularly-governed nation, the government is simply a committee of management; it will also be seen that this committee of management has no intrinsic authority. The inevitable conclusion will be that its authority is given by those appointing it; and has just such bounds as they choose to impose. Along with this will go the further conclusion that the laws it passes are not in themselves sacred; but that whatever sacredness they have, is entirely due to the ethical sanction—an ethical sanction which, as we find, is derivable from the laws of human life as carried on under social conditions. And there will come the corollary that when they have not this ethical sanction they have no sacredness, and may rightly be challenged.

The function of Liberalism in the past was that of putting a limit to the powers of kings. The function of true Liberalism in the future will be that of putting a limit to the powers of Parliaments.

COLORADO FOR INVALIDS.

By SAMUEL A. FISK, M. D.

THE romantic features of life in the Rocky Mountains have been so gracefully portrayed by such facile pens as those of Bayard Taylor, "H. H.," Miss Bird, and some of our magazine-writers, that the reading public have come to regard this country as adapted either to the tourist, bent on seeking something unusual, looking for novel and startling experiences, or else as an immense treasury of gold and silver, an El Dorado for the miner. But there is a larger class, that portion of our population throughout the East and South suffering from some pulmonary trouble, which should be much more interested in Colorado than either the pleasure-seeker or the money-getter. For such there is a wealth of life stored up in the dry, sunny climate of this State, more precious than the hidden treasures which the mountains contain.

It is the intention of the writer to supplement some past efforts in calling the attention of the public to this salubrious climate, by giving a few details in regard to methods of living, society, resorts, expenses, occupations for the invalid, etc.; and he is led to this by the lack of information that he has found, from a personal experience, exists among Eastern people in regard to these very points, and by the erroneous impressions which he finds most new-comers have as to what they are to expect.

Before entering into these details, it may be well to call attention, very briefly, to the climatic conditions existing in Colorado, which are favorable to the arrest and cure of a large percentage of pulmonary troubles. A careful analysis of Signal-Service statistics for a range of years has shown that the climate of Colorado affords an air only $\frac{4}{10}$ saturated with moisture, while the air of Jacksonville, Florida, is $\frac{7}{10}$, and that of Los Angeles, California, is $\frac{66}{100}$ of saturation; that the average rain- and snow-fall, per annum, is only a trifle over fourteen inches, while at Jacksonville it is forty-nine inches, at Los Angeles nineteen inches, and at New York forty-two inches; that the elevation, ranging from five thousand to seven thousand feet, is such as secures the most healthful action for diseased lungs; that the direction and daily motion of the winds are favorable and salubrious; that the mean temperature would place this climate under the head of a "cool climate"; and, lastly, and of the greatest importance, is the fact that it affords an average of three hundred and twenty sunny days per annum, or, to quote the article referred to:* "It is seen that in Denver there is only about one eighth of the entire year when an invalid would be kept in the house on account of the weather; in Jacksonville and Au-

* "Science," vol. ii, No. 35, p. 460.

gusta (Georgia) he would be confined to the house, for the same reason, one quarter of the year; in St. Paul he would be kept in-doors between a third and a quarter of the time; while in Boston he would have to be housed a good third of the time."

Many invalids who recognize the force of these data would, nevertheless, hesitate to come to Colorado because of their impression that the people are rough and only semi-civilized, and that the lack of accommodations is so great as to make life, especially for a lady, unendurable. Persons, gaining their information from newspapers, have a vague idea that the State is infested by the cow-boy element, that everybody carries fire-arms, that society is lawless or at the best crude, and that social life is regulated by the *nouveaux riches*. Such persons would be astonished at the facts in the case. In Denver they will find regular and well-laid streets, numerous and magnificent public buildings, imposing rows of business blocks, numerous and flourishing banks, stately churches, and, above all, comfortable and wealthy homes. A personal investigation will convince any one that Denver is the finest, cleanest, most healthful, and by far the most imposing, of any of the so-called new cities in the United States. It is a false impression that leads any one to think that affairs are crude in Colorado. Throughout the State, even in the smallest towns, are to be found people of culture and refinement. It is a noteworthy fact that the average of education is higher here than in almost any other part of the Union, and there is not a town in the State that is wanting a circle of people who have both read and traveled. It is also a mistaken impression that lawlessness prevails. In the mountains one can go anywhere unarmed, while in the centers life and property are as secure as in the East.

It is an equally mistaken idea that would cause one to hesitate about coming to Colorado for fear of the privations he would have to endure. Throughout the State the comforts of living, in any given place, are as great as they would be in a place of equal size East. Most of the towns are supplied with water- and gas-works. The markets have fruits and vegetables in their seasons, and fish and oysters from the coast. Such articles as groceries, clothing, furniture, are to be had as readily here as elsewhere. Hotel accommodations are as good as, if not better than, are to be found in most places of equal size East.

It should be remembered, however, that the expenses of living may be higher in Colorado, which is a new country, than in the older and more settled portions of the Union. This is to be accounted for partially by the fact that the home production is inadequate to the consumption, by the great distance that intervenes between this State and the centers of supply, and by the fact that it is impossible to grow certain things in this soil. As the question of expense is often of prime importance to invalids who would like to come to Colorado, it

may not be out of place to give a few brief details. A first-class railroad ticket from Chicago to Denver costs thirty-seven dollars; a berth in the sleeper is eight dollars; meals are seventy-five cents apiece. Hotel accommodations in Denver range from two to four dollars a day. Comfortably furnished rooms can be found at from twelve to twenty dollars a month, and good board costs from five to ten dollars a week. These are not bottom figures, but are means. House-rents and servants' wages are somewhat higher than in the East.

The invalid having determined to come to Colorado, the question then arises as to the best place for him to go. This is a point of considerable importance, and one in regard to which very erroneous advice is frequently given by physicians unacquainted with the State. For instance, it is not an uncommon thing for Eastern physicians to advise their patients to go into one of the parks in mid-winter, when, in point of fact, the snow would be lying so deeply on the ground in these places that it would be impossible to get into them, and certainly very injudicious for an invalid to attempt it. As a broad rule it can be stated that the best points in which to winter are the towns situated at the junction of the plains and foot-hills. In the summer the invalid will do well to go into the mountains, to such places as Estes Park, Manitou Park, Poncha Springs, Wagon-wheel Gap, Georgetown, or Idaho Springs.

The most available towns for the invalid who has to earn his support are Denver and Pueblo, but there is a moderately wide field from which to choose when health and comfort, and not money, are the main considerations. Colorado Springs combines so many favorable conditions of climate, good accommodations, pleasant society, and natural objects of interest, as to render it, in addition to its sanitary condition, an almost ideal resort for phthisical invalids. Six miles to the west of Colorado Springs, nestling among the foot-hills at the base of Pike's Peak, is Manitou, the so-called "Saratoga of the West." Its winter climate is mild, but it is chiefly a summer resort, as its large hotel accommodations, its iron and soda springs, its baths and drives, make it exceedingly popular. These springs furnish a large flow of agreeable drinking-water of real medicinal value. The soda-spring water resembles the Apollinaris, while the "Iron Ute" carries, in addition to the carbonates of soda, lime, and magnesia, a percentage of iron sufficient to give a marked reaction to the prussiate-of-potassium test. At Poncha Springs there is an abundant flow of a hot chalybeate water, containing in addition salts of sulphur, soda, lime, and magnesia in solution. The mean temperature of these springs is 150° Fahr., and they are considered to be very valuable in the cure of rheumatism and kindred troubles. The natural location of Poncha is one of the finest in the State, and it must in time become one of the well-known resorts. At present the hotel accommodations are meager and insufficient. Idaho Springs is a popular resort, adapted to both

winter and summer. The springs furnish agreeable bathing, the climate is mild and stimulating; it is so sheltered from the winds as to be warm, even in winter, and socially it is attractive. The hot springs at Las Vegas, New Mexico, combine the advantages of a good winter climate, excellent hotel accommodations, and baths of natural hot water. The temperature of these springs varies from 71° to 136° Fahr., and they contain salts of soda and lime. We give tables showing the constituents of these several waters:

IN 100,000 PARTS OF SPRING-WATER ARE CONTAINED—	MANITOU. Iron Ute, 44° F. (Wheeler expedition).	MANITOU. Soda, 44° F. (Wheeler expedition).	LAS VEGAS. No. 13, 136° F.	IDAHO SPRINGS. 110° F.	WAGON-WHEEL GAP. 150° F. (Wheeler expedition).
Carbonate of soda	59·34	88·80	1·50	52·81	69·42
Carbonate of lithia	trace	trace	....	...	trace
Carbonate of lime	59·04	108·50	3·01	16·32	13·08
Carbonate of magnesia	14·56	....	....	4·94	10·91
Carbonate of iron	5·78	....	....	7·07	....
Sulphate of potassium	7·01	5·12	....	....	trace
Sulphate of soda	30·86	37·08	17·72	50·34	23·73
Chloride of soda	31·59	42·12	28·03	7·13	29·35
Silica	2·69	trace	6·16	6·99	5·73
Solid residue	....	....	57·00	....	trace
Sulphate of magnesia	....	....	....	32·09	....
Total	210·87	281·62	113·42	177·69	152·12

Denver itself makes a good winter resort, as it combines the comforts and attractions of a city with a dry, warm, and sunny climate. But no directions can be given as regards the place that is best suited to any individual case; that should be determined by some competent physician who would take into consideration the demands of the case and the season of the year. In the summer it is well for the invalid to go into the mountains, either camping out or going to some of the resorts; in the winter, let him do as the Indians did, come down to the edge of the plains.

The inclination to exercise to excess and to overdo is a tendency which the phthisical invalid should guard against. The increased activity of the heart, bearing in its train an increase of metamorphosis and an exalted vitality, frequently leads the invalid to overrate his strength and to exercise too violently. In this way irreparable injury is not infrequently done. The exhilaration produced by the tonic air, coupled with the restlessness incident to change of scene, often induce patients, who should be resting and becoming acclimated, to take long and exhausting walks, or to ride distances that would tax the energies of a well man. It is difficult for most phthisical invalids to understand that they are not as strong as they once were, and to teach them that exercise does not mean exhausting effort. There is a wrong impression, common to this class, which leads them to think that in order to

regain health they must be in constant motion, and that the more they can be doing the sooner they will get well. They forget that their disease is in itself a tremendous drain upon their vitality, and that any additional strain is to be avoided. When the heart has become accustomed to the additional work put upon it, by reason of the increase in elevation, and the system has adapted itself to the new conditions by which it is surrounded, it is well to undertake exercise of a moderate character, and the best is riding horseback. Fortunately, the price of ponies (from sixty to one hundred dollars) is so reasonable and the sport so popular as to make this form of exercise both possible and attractive to every invalid.

There is another fallacy inherent in the minds of many consumptives, coming to Colorado, which should be mentioned; that is the idea that the climate is the only factor in the cure of phthisis, and that it will be sufficient for them simply to be breathing this dry air in order to secure a complete recovery. It is most absurd to imagine that an invalid can disregard all the laws of hygiene and health, can keep irregular hours, smoke incessantly, disregard all changes of temperature, expose himself in every possible way to cold, in order that he may become "toughened," and then expect that the climate is going to work wonders in curing his trouble. And yet many a one, leading just this type of life, grumbles at the climate, and wonders that he does not recover his health!

This leads us to speak of the matter of clothing. The ranges of temperature in Colorado are often very large, hence a person should be prepared for both warm and cold weather. In winter one should wear flannels and heavy clothes just as in New York; in summer thin garments will be comfortable at midday, but woolens will be needed at night. The air is so dry and rare, and the soil is so exposed and sandy, that both solar and terrestrial radiation are rapid. The sun's rays heat rapidly, and, they being withdrawn, the air is rapidly cooled. There is, however, this positive fact which makes thermometric variations unfair criteria on which to base comparisons as between Colorado and the East. As has been shown, this air is exceedingly dry, and consequently heat and cold, as indicated by the registration of the mercury, are not felt as much as in New York. Mists are seldom seen here, and dew is rarely deposited.

The question of occupation for the invalid is one of prime importance, and has almost as direct a bearing upon his recovery as have climate and proper care. Even if it be true that consumptives are, as a rule, sanguine about themselves, it is equally true that, if a man has nothing to think of but his health, he soon becomes a hypochondriac—a disease as much to be dreaded as any real malady—and every physician, who has had much experience with chronic invalids, knows how important it is that the mind should be "diverted." The writer regards it as a great mistake for the phthisical invalid to be with-

out some definite plans and occupation. As soon as practicable, it is advisable for such a one to take up some pursuit, either of business or of study, which will give such occupation as is consistent with his physical condition. The geology, mineralogy, fauna and flora of this State, so rich in themselves and so different from those in the East, furnish, to one so disposed, ample fields of study and inquiry, the pursuit of which will be a help rather than a hindrance to recovery. The collecting of a cabinet, requiring as it would something of an out-of-door life, or the getting together of an herbarium of all the choice and unusual flowers and plants of this State, would furnish occupation of an instructive and diverting kind. If one undertakes to study even the birds, he will be surprised to find how many species there are, and will be equally astonished to discover among them his old friends the bobolink, wren, oriole, and the indigo-bird, of the Eastern States.

It may be a good thing for the person affected with phthisis to go into ranching, after he has been in the State long enough to know what he is about in doing so; but we enter a protest against the idea, which is somewhat prevalent in the East, that in order to recover his health the invalid should go on to a ranch and herd sheep. The reasons for making this protest are that such advice is frequently given, and, as we are led to judge, by physicians who have but the vaguest ideas of the nature of the course they are prescribing. The invalid, on coming to Colorado, needs to have life made as easy and pleasant for him as possible. As a rule, the sacrifices he has to make, in consequence of his sickness, render him for the time being peculiarly dependent upon sympathy. He should be so situated that he can have the benefit of pleasant society and diverting companionship. Now, ranch-life is necessarily somewhat rough and usually monotonous, and, when it comes to herding sheep, even a vigorous man, new at the business, finds it most irksome and fatiguing. We think it is a great mistake to increase the trials of an invalid by imposing upon him, in addition to a separation from his friends, an almost entire absence of companionship, a life that is rough in the extreme, and a dietary that is innutritious, uninviting, and monotonous. The average ranch-house is a miserable shanty, out on the plains, away from neighbors, where the usual diet is bacon floating in grease; hot flapjacks, made fresh with water and baking-powder; molasses, and coffee without milk.

If it be possible for the invalid to go to some nice ranch, near a village, where he can have good, wholesome diet, pleasant associates, out-of-door occupation, and where his hours will necessarily be regular, then the conditions for recovery are excellent. Such ranches are to be found. But the average ranch, on the plains, is much inferior to the average farm-house in the East, and the surroundings and diet are such as, at first, to try very severely the strongest man.

The matter of diet is one to which, as it seems to the writer, sufficient attention is not usually paid by the invalid. He should be so

situated that he can have an abundance of plain, nutritious food, well cooked, and a variety sufficient to invite the palate. It stands to reason that if the waste in the system, produced by the disease, is not only to be made good, but if, in addition, as is desirable, the patient is to put on fat, he must take into his system material sufficient in quality and quantity wherewith to do it. Any place, be it on a ranch or at a boarding-house, where the table is uninviting and nauseous, is a bad one for the invalid, and one that he should leave as soon as possible. It is on this ground that we base a good deal of our objection to ranch-life. As indicated, the food is usually poor in quality, insufficient in quantity, and indigestible. Contrary to what might be supposed, even on a cattle-ranch, milk is seldom to be had, and, if the black coffee is to be drunk *au lait*, it is made so with condensed milk. The life, also, is monotonous and trying, and the distance from medical assistance, if needed, is so great as to be, in hæmorrhagic cases, of serious importance. The writer is convinced that ranch-life, the so-called "ranch-cure for consumptives," especially those just out from the East, is a mistake; and he is certain that its good qualities, in giving occupation and an out-of-door life, are to be had without the bad ones, by going to some one of the many towns on the eastern slopes of the Rocky Mountains.

In conclusion, it may be appropriate to speak very briefly of the classes of pulmonary troubles to which this climate is adapted. It will not be possible to give a complete list, nor to attempt to catalogue the varieties, but merely to mention, in the most general way, the kinds of pulmonary disease that experience has shown to be relieved in Colorado. It may not be inappropriate to begin with a strong negative, and to say that this climate is *not* adapted to persons suffering from the last stages of phthisis. The elevation and rarity of the air throw so much extra work on the already embarrassed heart and lungs that the difficulty is increased and the end is only hastened. Such cases need the comforts of home, and the consolation of friends, more than change of scene or climate; and we protest against the cruelty of sending such invalids to Colorado as a *dernier ressort*, when the probable issue will be that they have been subjected to an exhausting and fatiguing journey only to give up their life, in a short time, in a strange land. The opinion that the altitude is not suited to hæmorrhagic cases is generally discountenanced by the medical profession in this State. Such cases are found to do very well here if they be taken early enough; and experience shows that there is nothing in mere altitude to increase the tendency to relapses. Even those cases where there is a strong hereditary tendency to phthisis are found to do admirably in this climate, provided they come early enough. The so-called catarrhal pneumonias, in the early stages, where resolution is slow, are admirably adapted to this climate. Bronchitic and asthmatic patients find relief and cure here. Where heart-lesions exist, especially

if they be complicated with dilatation, elevation is contraindicated. Many cases of nasal and pharyngeal catarrh do admirably here, and deafness, arising from chronic catarrh of the middle ear, is frequently cured. In general, Colorado will be found to be an admirable resort for enfeebled and debilitated persons who need rest, change of scene, and general "toning up."

It has become a by-word that there are two classes of persons who come to Colorado—those who come to get health, and those who come for wealth. We think that the former more often realize their anticipations, and, having found a new interest in life, in consequence of their return to health, they show their appreciation and gratitude by remaining in the air and sunshine that have made "life new around them." How often one hears the expression, "I owe everything to Colorado air," it is impossible to say; but so large a class of our population have sought and found a restoration of health here, that one can not refrain from carrying the good tidings to the thousands upon thousands in the East who are seeking wherewith they may be cured.

THE NEW THEOLOGY.

By Rev. GEORGE G. LYON.

ASSUMING that the Being worthy of the highest adoration in heaven and on earth must be incomprehensible, and that his will and ways must be past finding out, no conceivable symbol can be final, or can be either satisfactory or helpful, except in a period of immaturity; and hence nothing can be more necessary than a new faith, or more reasonable than its confident and constant expectation; and that which is now dawning on the Christian world is doubtless destined to have its day. They who have toiled hard and borne the heat and labor of the preceding day and feel the need of rest, and they who dislike the dawn and love to slumber until noon, will be more annoyed than gratified by the light of this new morning; but they who are up with the rising sun will be delighted with the dispersing darkness and the increasing brightness, and with the new beauties and the fresh fragrance of the clearer light and higher life.

Thus far in its presentation the New Theology is reformatory rather than revolutionary in its teachings and tendencies. It accepts the nomenclature of the Old, but shades or expands its definitions so as to accord with the subtiler experiences and the enlarged observations of the age; and it maintains the dogmatic statements of the Old, but modifies their exposition so as to bring them into harmony with the laws and processes of being. It affirms with the Old that faith is the basis of salvation and of all deliberate activity, but it gives no

pre-eminence to any form of faith, and tests the validity and the sufficiency of a faith by the salvation it secures and the activity it inspires. With the Old it accepts all Scripture given by inspiration as divine, and interprets Scripture by Scripture, but it holds in abeyance all biblical utterances which seem unreasonable, and rejects all which are in conflict with the nature of things or the course of Providence, and aims to understand and to corroborate the written word by the works of Nature; and it maintains that no portion of the Scripture can be a revelation of God to man except to the extent that it is understood and conforms to the laws of being.

One of the most distinguishing characteristics of the New Theology is its respect for science, indicated by its effort to put all its statements on a scientific basis and submit them in a scientific method, and to question the value or utility of any doctrine which does not come under some general and harmonious law, or which can not be scientifically presented; and, were this the only claim of the New Theology, it would entitle it to a respectful hearing, as well as put it in striking contrast with the Old. It does not insist that any of the great doctrines derived from the Bible could have been discovered by scientific investigation, but, being disclosed by divine inspiration, as claimed, they are, when philosophically considered, recognized as reasonable and essential, and to be in accord with the constitution of things. It contends that the dogmatic teachings with respect to the trinity of the Godhead, the divinity of Christ, the atonement or human redemption in Christ, the inspiration of the Scriptures, the immortality of the soul, salvation by faith, the operations of the Holy Spirit, human probation, the eternity of divine rewards and punishments, and other biblical doctrines, are no longer to be announced as abstract truths to be received by a stultified credulity and denied at the peril of the soul, but are illumined under the light of philosophy as natural and essential, and can be as rationally believed as any other inexplicable statements of experience or observation.

As a corollary to this respect for science the New Theology has an antipathy to authority, and insists on personal freedom in investigation, and personal responsibility for conviction. It concedes that authority is necessary as a guide in immaturity, and that most of the knowledge acquired by individuals is derived, but holds that no *ipse dixit* is final, and that all communication is to be received tentatively and subject to amendment or rejection; that authority is merely mechanical in its action and in its effect, and that they who submit to it without question are mere machinery propelled like an engine by steam, capable of valuable service for a season, but neither develop nor improve, and are deprived of all the pleasures of progress and of increasing vigor and usefulness. It goes further, and charges that commanding authority dwarfs growth and weakens ability, and is, therefore, largely responsible for the general inability to distinguish

between right and wrong, and for the unsettled and weak convictions as to good and evil; and, furthermore, that it is accountable for much of the prevailing unbelief and skepticism, for, without some collateral and corroborative evidence to support naked affirmations, faith becomes weak, and lapses into superstitious credulity, or is abandoned for the more satisfactory—if not more intelligent—negations of infidelity and agnosticism. And it must be admitted that it has always been difficult to hold the average of Christians to an unfaltering faith in the evangelical doctrines of Christianity—the Trinity, the divinity of Christ, the atonement, etc.—that but few have a clear conception of any of them, that many deny one or more of them, that no two understand them alike, and that all have doubts and fears with respect to them; and, therefore, the New Theology most earnestly protests against the arbitrary and inconsiderate church canon which exacts unreserved or even nominal assent to all or to any articles of faith as a requirement of God and a condition of the divine favor and the soul's salvation. It does not question the soundness of the doctrines affirmed, but it recognizes the impossibility of making all men see them alike, or of holding them to a credulous assent to them; and affirms that many who doubt and many who disbelieve them are among the most exemplary of mankind; that the sacred Scriptures comprehensively understood do not exact uniformity of faith in order to salvation; and that were any symbol the basis of hope it could not be of universal application, and would, therefore, not be adapted to humanity, or be consistent with either the divine or human nature. It assumes that saving faith is that recognition of what is right and best which enforces its practice; and the sincerity and strength of faith are determined by the degree of the conformity of the heart and life of the subject to the character and requirements of the ideal. In other words, the aim and effort of a man to be in accord with what he sincerely regards the true and the perfect, whether that be fetichism or Christianity, is the exercise of saving faith, and secures the soul its highest commendation and the divine favor; and, since its real excellence is in sincerity, it may be as perfect and as acceptable in its first timid appliance by the feeble as in its last bold assurance by the strong.

The New Theology is not a positive philosophy which rejects or agnosticizes the unknowable and the incomprehensible. It accepts authority as the starting-point of inquiry, which is skeptical but open to evidence, and takes the reasonable and the probable rather than the positive or the absolute as the only attainable presumption of truth and error. And since problematic conviction constitutes the sum of all human knowledge, and forms the basis of all human activity, it regards as impractical theorists, insensible to the operative agencies of the ages, all who reject the probable for the positive.

Starting out with these leading ideas that no creed can be final so

long as there is the infinite to explore or the human intellect is capable of comprehending more; that new symbols are of periodicity and of rational expectation, and therefore that all creeds are tentative and adapted only to a transition period; that authority is insufficient, and requires the corroboration of correlative facts or principles of observation to establish faith; that no formula of faith can be adjusted to all comprehensions or made the condition of salvation, and that the probable is the highest and the sufficient warrant for all human faith and practice—it remains to be seen if the New Theology has a clearer or a fuller apprehension of scriptural teaching, and if it can present its ideas less dogmatically and more scientifically, or as authoritative utterances corroborated by corresponding facts or experiences which are generally accepted.

No adherent of the New Theology, however enthusiastic or confident in his early love, presumes that in this dawn of its day its beams are as bright or broad as they will be at its meridian; and the most zealous of its expounders confess that in its present stage it is largely suggestive, and possibly adapted to arrest the reactionary tendency to reject all scriptural teaching as of divine origin or authority on account of the unreasonableness of some of the current theological interpretations and expositions, and to unite thinking Christians and confirm the weak and the wavering in the faith of the gospel, by such a presentation of scripture truths as will be commended by their judgment, and will show them to be essential to human welfare and analogous to the laws and phenomena of Nature. It is therefore chiefly a contribution of suggestive definitions and methods applied to the popular or evangelical theology. But, in order to a clearer idea of the New Theology and its methods, it is necessary to give a brief statement of its presentation of some of the more prominent evangelical doctrines, and especially of those which within the last few years have been made conspicuous through church councils and the religious and secular press, as the atonement, the work of the Divine Spirit, human probation, etc.

As to the nature and necessity of the atonement, the New Theology is perhaps more perplexed than as to any other evangelical topic, if indeed it is not agnostic, or at least without decided convictions; and its adherents consider themselves as mere inquirers, investigating in an obscure light its profound mysteries, trusting that the dark labyrinth in which they are groping will lead to their fuller disclosure. It does not deny that in some way the mission of our Lord accomplished immeasurable good to mankind, for it recognizes a new and diviner life issuing from Calvary and streaming down through the centuries in ever-increasing volume, purifying the hearts and inspiring the lives of men, and constituting the impulsive force to all that is desirable and divine in human progress; but it can not reconcile with a worthy conception of either the divine or human nature the punishment or the

suffering of the innocent for the guilty in order to placate the divine anger and render the Deity propitious, or to satisfy the claims of justice so that the Judge can be clement to transgressors of law and permit them, untrammeled by guilt for the past, to reform, or give them another chance to do better. Neither the divine holiness nor justice was ever antagonized to the sinner, and therefore never needed to be conciliated, and certainly neither could ever be reconciled with sin; so that an atonement either to dispose God favorably toward sinners or to tolerate sin, or to make any allowance for sin or to pardon sin, is inconsistent with the divine nature. And nothing can be more absurd than the teaching that God was at enmity with the sinner, unless it be the affirmation of those who believe it, that the atonement is "a provision of divine grace or love"; for, plainly stated, it is this: An atonement or means of reconciliation was necessary because God hated sinners, but was really instituted because "God so loved the world" of sinners. Men feel that God is angry with them and hostile to them, but certainly the atonement of Christ, whatever it be, is counteracting this erroneous sentiment by its disclosure of the infinite and unwavering paternal love of God for man in the life and death of his Son; and any provision of mercy which the divine wisdom and goodness has made for sinners is necessarily predicated on this infinite love of the common Father of the race. And so the New Theology objects to all moral views of the atonement which make provisions for waiving any legal process or infliction of penalty, and holds that no new provision of grace or special scheme of redemption for the recovery of man from the power and dominion of sin was necessary; that all the elements for the restoration from sin to righteousness are included in the provisions of Nature, and are sufficient when quickened and invigorated by the Divine Spirit to reinstate men in holiness and in the favor of God. So that the regeneration of the human soul is as practicable without the mission or work of Christ as an additional agency as with it, for it consists essentially in the deliberate determination henceforth and forever to be at one with God; and from this determinative initiative the optimistic element of the mind brings the peace, courage, and hope of faith. There is nothing now to afflict or discourage except the past, and that is forsaken and abhorred; and since in eternal progress, and effort the soul is in accord with the laws of its being and the Divine Will, it gradually comes to forget, as God does, its backslidings, and to think only of that which is pleasing to God and which will be the source of perpetual delight.

It would not be consistent with the general run of creation had remedial provisions been left out of the moral nature of man while they are incorporated in animal, in vegetal, and in social being; nor would it be consistent with the infinite forethought or consideration or compassion of our Father in heaven to introduce a new agency essential to human welfare which was not of immediate and universal ap-

plication to the race. It is true, the advent of Christ was of intermediation in time, but in essence of being it was contemporaneous with accountability, and was revealed in prophetic language at the first overture of moral delinquency as the seed of the woman "that should bruise the serpent's head"; and has ever, according to all human experience, been recognized in the ideal of good which reproaches every varying thought and deed, and which constitutes the inspiration and the encouragement to all improvement. The advent and life of our Lord did not therefore impart a new moral element to the world, nor is Christianity a new provision of grace in the plan of human redemption; and the time element in their introduction is a mere question of policy, since they are not of vital importance. That is, it was for divine wisdom to determine when it would be most advantageous to the race to send the quickening example and teaching of Christ into the world, but their advent has in no way modified the relation of God to man, or of man to God, nor made the provisions of human redemption more ample or available. They are incidents in the process of moral progress, and could wisely be introduced only at the proper stage of development, so that the delay in their intercalation can not be reproachful.

The aim of the atonement is to exemplify a condition and life corresponding to, but surpassing, the highest ideals of men, which may be approximately attained by every individual of the race in every stage of accountability; and the effort to realize this condition and life is the acceptance of its provisions and its accounted righteousness or the transfer of Christ's righteousness to the believer; for the faith that impels to be like Christ is transforming in its effect, and by its continuous exercise believers become Christ-like in character and conduct. And this has ever been the result among heathen and Christians of efforts to attain ideal excellence; for the human mind is so constituted that its desirable ideal is always an approximation to the perfection of Christ; and hence the declaration of Peter, "I perceive that God is no respecter of persons, but in every nation he that feareth him and worketh righteousness is acceptable to him"; and hence, also, the Christ-like worthies among Hebrew saints and pagan philosophers, Mohammedan dervishes, Indian fakirs, and fetich-worshipers. Moral processes, corresponding to those accorded to the atonement of Christ, have been going on in all ages and among all races, regenerating the hearts and improving the conduct of all believers—i. e., of all who aimed to realize their ideal excellence; and this regenerating process was probably signified in the occult religious mysteries of the more cultured nations of antiquity. The atonement, therefore, is not a provision for sin or for the sinner, but for man; and, had sin never entered the world, the mission of Christ would have been as necessary to the exaltation and salvation of mankind as it is under the reign and power of sin. It is a practical revelation of an ideal which was essen-

tial to the highest good of man, and which could be eternally approximated, but which never could be conceived by man without its disclosure in the life and death of our Lord.

In regard to the supernatural, the New Theology doubts or denies it in the economies of Nature and of grace. It believes in the inspiration of all scriptural and other truth, in the authenticated phenomena called miracles, in the regeneration of corrupted human nature by the power of the Holy Spirit, and in the active and efficient superintendence of divine providence; but it maintains that the divine immanence in the world is sufficient to account for the minutest and the mightiest phenomena which have occurred, or which can take place, and that to assume special divine interferences or the interposition of new agencies in the communication of the Divine Will, in the government of the material or moral world, in the recovery of man from wickedness to righteousness, presumes the "sober second thought" on the part of God that his original executions were defective, and needed amendment or reformation; that he is partial, and favors with advantages one age or one class more than another, and that he is changeable and unreliable. All natural wants, physical and spiritual, are indicative of the divine disposition to help, and are assurances of suitable supplies—material for the body and immaterial for the mind—which, according to all human experience, never ignore nor supersede a natural law or function; and it is doubtful if any supernatural helps could be recognized or appreciated; so that it is not improbable that all that is called supernatural is of misconception, superstition, or credulity. And, if there be no necessity for it, or if that which is so called can be accounted for or accomplished by natural means, its exercise would be a useless display of energy, while, if necessary, it shows that the provisions of Nature are inadequate to its necessities and thereby reproach their author; and if it intervenes to assist, or retard, or counteract, it must be a supersedence of the supernatural by the supernatural—a kingdom divided against itself and self-destructive; for is not Nature, in its being and in its processes, a divine arrangement and incapable of any modification or rearrangement except by a greater than Nature? And to the affirmation that all the divine creations and phenomena are necessarily supernatural, it may be asked: How can there be a supernatural without a natural to exceed? and if supernatural, how can they be superseded unless by a greater than the supernatural? and would it not be useless to introduce the supernatural unless it could exceed a process of Nature or equal an act of creation?

But who knows what Nature is capable of? or if it has ever been superseded? or that any of the operations called supernatural are more than natural? As mankind advances in intelligence, the supernatural retires, like barbarism before civilization; and yet, the prevalent belief of Christians is, that there is a supernatural, spiritual agency in the world which enlightens the mind and transforms the heart of

man, and which assures of the divine favor and begets the hope of eternal life; and a less prevalent conviction that this divine element has in times past performed miracles, and may even now be controlled to heal the sick, and cure the lame, and do superhuman deeds.

It is not questioned that there is an enlightening, encouraging, and comforting spiritual influence in the world; but why assume that it is supernatural? or that it is a new and distinct agent which is superior to and supersedes Nature? No one has yet fathomed the mysteries or power of a single element of nature, and therefore can not reasonably assume that Nature is insufficient to account for all the phenomena attributed to the supernatural, nor can any one show that the supernatural has ever done or can do more than is done by Nature in its ordinary processes. And if, as claimed, the natural occurrences are divine operations, then, certainly, no supernatural agency could be more subtile, or more powerful, or more beneficial, than a common process of Nature. Even the advent of Christ can not be regarded as a new or superseding force in human life if he be "God manifest in the flesh," for God has ever made himself known by his works and providence, "even his everlasting power and divinity." The mere form of his appearance would not be a superior component, and if he were a creation he could not be a supernatural power.

The profound conviction of the Christian mind is, that the God who created, upholds the universe, and watches over and guides the movement of every atom day and night, and guards the thoughts of every heart and gives them the impulse of their transforming energy. This is the divine in nature, and there could be no course of nature without it; but it is neither a new, nor a distinct, nor a superseding element in nature. It is God as the ever-present and efficient force in matter and mind, who "rides in the whirlwind and guides in the storm," who lives, and moves, and has his being in the human heart, and who helps in every infirmity. He is the unseen, intangible subsistence in and of self, and yet not self, which purifies the heart and ennobles the life, and which improves society, and "makes for righteousness" from age to age, and to the ends of the earth.

He is the Holy Spirit, sent by our Lord, who vitalizes every letter and word of the Divine utterances, and abides in them so that they are living words, and scintillate with the radiance of their divine significance as the light from the urim and thummim of the high-priest of old, and as the shekinah from the mercy-seat between the cherubim over the ark of the covenant. He is the light which enlighteneth every man who cometh into the world, the persuasion in every invitation, the comfort in every promise, the encourager in every prediction, and the inspiration in every hope. Every sigh over a wrong is of his awakening; every smile started by a kindness springs from him; every incident that teaches some good to do or some evil to shun is

his persuasive voice, and every movement toward righteousness is the impulse of his impending presence.

According to his word, God is in man, living and moving of his own good pleasure; not beyond his reach nor without him, but in him and of him, and may be recognized in every stone and star, in every glint of beauty and waft of fragrance, in every touch and tone of tenderness, and in every strain of melody and movement of intelligence. What, then, would be the use or the value of the supernatural in nature?

As to the scientific dogma of the evolution of man from monad through monkey, the New Theology is as ready to accept it as to reject it, according to the evidence; but in no event does it see the necessity of nor admit a special divine interposition to complete any stage in the process, and it is unscientific to assume it. The divine immanence is constant, and is sufficient for every evolved condition without aid from or resort to unnatural or supernatural supplementation to the uniformity of nature; and, whether evolved or not, man is consciously and practically a moral being, capable of virtue and vice, and justly censurable for evil and worthy of commendation for good.

But, more than any other, the topic which has made the New Theology most conspicuous is that which is denominated a second probation, which is yet illy conceived and variously presented. Consistent thinkers not only accept the doctrine of rewards and punishments, but hold that neither can adequately express the Divine attitude toward holiness and sin, nor man's sense of propriety and justice, unless they be eternal. They do not assume to describe the rewards or the punishments of the future, nor to know their constituents, but presume, from their appropriateness, and from the consistency in the order of divine things, that they will be similar to or identical with the peace and joy of believers, and the commotion and wretchedness of sinners on earth. From this point the New Theology shades off gradually from the Old. It holds that sin involves death or permanent disability, and that continuous sinning becomes increasingly disastrous, undermining and weakening the moral nature, until it becomes so enfeebled as hardly to be able to perform or to enjoy the pleasures of a virtuous deed, and logically terminates in the extinction of moral being. But since, according to Scripture and science, nothing is made in vain, or to be destroyed, there must be hope where there is life, and since the annihilation of any existence implies a useless act in its creation, or an error in the calculation of its author, it assumes that being, especially moral being, is an assurance of immortality, and that so long as there is a spark of vitality there is a possibility, or, according to the nature and course of things, a probability of an awakening to a higher life and its eternal development. And if, with the diminution of moral energy referred to, there is, as is claimed, an element of pain as a corollary of transgression, it is an additional evidence of the

probability of reformation and growth, for suffering is not a penalty in token of disapproval, but a sign of mercy and an agency of restraint and reformation. The penalty of sin is death—an eternal disability—and the pain that accompanies it is its symptom demanding attention, and the application of curative remedies. As the pain of a burn, the gnawing of hunger, the distress of fever, are symptoms of threatened danger which indicate the localities in jeopardy, the disintegration of the tissues in process, and call for help, and disturb until relieved; so the fiery darts of sin, the cravings from spiritual inanition, and the restless ferment from corrupt desires and vicious practices, give the alarm of moral dissolution, and cry "with groanings unutterable," until the remedies are applied and the cure is effected. So that suffering, physical and spiritual, is the cry for mercy from the depths of transgression, and is the sign of hope and the assurance of a "present help in time of need," unless the desire of sufferers exceeds the measure of the divine and human compassion. If, therefore, life is continuous and pain accompanies penalty, the possibility of recovery from the pain of transgression and of a new opportunity in life must be their concomitants, and last as long as "life and thought and being." So that penalty, so long as it is accompanied with pain, is an evidence of probationary being, and there is certainly no philosophic nor scientific reason, and probably no biblical teaching, incompatible with these two principles—the continuity of life, and the remedial nature of pain; and, therefore, it may confidently be affirmed, *where there is pain there is hope.*

But probationary life is not hypothecated on continuity of life, nor on any remedial provision in life, but on the essential nature of morality. The phrase "*second probation*" is misleading, so far as it implies a continuity of condition or state. Each moral act—i. e., each deliberate act for which a moral being is responsible—completes a probationary period, so that a moral life is a succession of periods in which deliberate choice, or the acceptance or rejection of ultimate good, is expressed. Probation is, therefore, of instantaneity and not of continuity, except so far as continuity indicates a succession of moral or probationary processes; character is the tendency evoked by the last determination; virtuous life is a succession of best choices, and finite moral being and morality terminate with probation. There is a disposition in the human mind to repeat its acts, and it acquires the facility of habit by its repetitions, so that one virtuous or vicious act heralds another, but each volition determines, as it also indicates, the character, and therefore, if there be virtue in the future, it must be predicated there as here on a probationary existence, and be secured by deliberate choice. And to the objection that this *postulatum* renders the conditions of the future as uncertain as in the present, it need only be said that the ordinances of Heaven are not regulated by speculative philosophers or theologians. But why should the conditions of

the future differ from those of the present? Is God variable or partial? Is not a probationary existence here wise? Could there be virtue or vice, happiness or wretchedness, without it? Could there be virtue or vice under constraint? Would obedience or disobedience that was perfunctory, or a sequence, or of habit, were it possible, be of any moral quality so as to be either pleasing or displeasing to God, or profitable or damaging to the soul? Or is there any greater probability of falling from virtue hereafter than here? But virtue is impossible anywhere without the alternative of vice; and, since the tendency to repeat is confirmed by repetition, and since virtue only accords with or is agreeable to the soul, is it not probable that the acquired taste for virtue shall continually increase until all other inclination of the soul shall cease, and virtue shall be loved for itself, and be practiced because it is so loved? And so vice can only be vice when it can be rejected. It, too, may be pursued to a habit, but it is always hostile to nature, and can never be relished; so that, since it is unnatural and disagreeable and unnecessary, it is not improbable that it will be resisted and ultimately be superseded by virtue; for will not the "evil" always "bow before the good"? This, at least, would be in accord with the order of nature, and could neither minify penalty nor reproach law, and would vindicate the divine righteousness in the creation and redemption of man, and be the fullest and the grandest exhibition of the divine wisdom and love to the intelligent universe.

To compass this end, Christian theology has resorted to purgatory, universalism, restoration, annihilation of the wicked, second probation, and other subterfuges, and has sought in scriptural teaching and in natural processes for a theodicy that would relieve the Creator from the reproach of the eternal punishment of sinners. To a greater or less extent all these schemes to rescue man from the unquenchable fire and the gnawings of the undying worm, or to justify their infliction, are evoked by shame or horror at the extreme severity of the penalty, and express the modifications which human wisdom and tenderness would interpose or substitute. They not only reproach God for inhumanity, but overlook the fact that his law could not be sanctioned nor be worthy of respect were its penalties either variable or transient.

Death—eternal disability—must follow the first and least as well as the last and greatest transgression, and the eternity of its infliction is based on sin and not on continuous sinning. But death does not end life. It is a stage in a process which marks the decay or loss experienced by a wasted moment or a neglected opportunity which never can be recovered, and the beginning of a new opportunity in life, and can be no more reproachful in its recurrence than in its incipience. The eternity of the reward and punishment is not only an expression of the sanctity of the law, but of the divine respect for it,

and leads its subjects to reverence it that they may enjoy its benefits and escape its condemnations forever. So that eternal punishment is adapted to awaken pleasure and gratitude rather than shame and horror, and needs no sentimental theodicy of human contrivance to justify it or to reconcile it with divine or human nature.

The New Theology does not claim to make men better Christians, for it teaches that the divinest character is formed by striving after the best, and that no intellectual belief or formal creed can improve moral nature; but it aims to give clearer and more rational ideas of God and his will and ways, and to present Christianity in a more attractive form and with an enlarged scope to its province. It contemplates the divine Creator and preserver with reference to his moral creation chiefly in the light of a loving Father, immanent in all the works of his hand, directing and supporting in every motion, and controlling all forces and agencies so that they shall be in harmony with his law and work together for good. It defines Christianity as that which is worthy of God and becoming to man, and accepts as Christian teaching and life everything from every source which accords with and promotes godliness. It recognizes and adores Christ as the manifestation of every conceivable attribute and desirable quality contained in the infinite Godhead, and as the only sufficient and perfect Saviour of mankind; and it holds that faith which seeks to be possessed of the mind of Christ regenerates the heart and makes the life Christ-like, and secures salvation to mankind by the divine or Christ-like possessions it imparts. It acknowledges as acceptable worship to the true God the sincere devotion that is paid to any god, and insists that this is conformable to sound reason and sacred Scripture; for no two devotees of pagan altar or Christian shrine conceive the same God, so that there must be as many gods as men; and certainly any creed that does not include sincere idolatry and fetichism as acceptable forms of worship to him who is high over all, blessed for evermore, is less tolerant than Brahmanism, which teaches that they who have not discovered the highest God may worship lower gods, and also than the Supreme Vedic God who three thousand years ago declared, "Even those who worship idols worship me."

It maintains that the Christian religion appertains to the whole life, and defines it as the purpose to do God's will in everything, or "to do with our might and as unto the Lord whatsoever our hands find to do." It makes the threading of a needle as sacred as a sacrament. It seeks to do as God would do in eating and drinking, in buying and selling, in speaking and thinking, in work and play, in personal indulgences, and in administering to the needy. Everything to do is a religious duty and an opening to diviner capability and enjoyment, and anything done that is not intended to please God or to achieve the highest good is irreligious or infidel.

OUR DEBT TO INSECTS.

By GRANT ALLEN.

IT has often occurred to me as a curious fact, when I have been watching the bees and butterflies in an English meadow of a summer morning, that no one should ever yet have adequately realized (so far as I know) the full amount of human indebtedness to those bright and joyous little winged creatures. I do not mean our practical indebtedness to insects for honey and bees'-wax, silk and satin, cochineal and lacquer, or a hundred other such-like useful products: these, indeed, are many and valuable in their own way, though far less so than the tribute we draw from most of the other great classes of animal life. But there is one debt we owe them so out of all proportion to their size and relative importance in the world that it is strange it should so seldom meet with due recognition. Odd as it may sound to say so, I believe we owe almost entirely to insects the whole presence of color in nature, otherwise than green; without them our world would be wanting in more than half the beautiful objects which give it its greatest æsthetic charm in the appreciative eyes of cultivated humanity. Of course, if insects had never been, the great external features of the world would still remain essentially the same. The earth-sculpture that gives rise to mountains and valleys, downs and plains, glens and gorges, is wholly unconnected with these minute living agents; but all the smaller beauties of detail which add so much zest to our enjoyment of life and nature would be almost wholly absent, I believe, but for the long-continued æsthetic selection of the insect tribes for innumerable generations. We have all heard over and over again that the petals of flowers have been developed mainly by the action of bees and butterflies; and as a botanical truth this principle is now pretty generally accepted; but it may be worth while to reconsider the matter once more from the picturesque and artistic point of view by definitely asking ourselves, How much of beauty in the outer world do we owe to the perceptions and especially to the color-sense of the various insects?

If we could suddenly transplant ourselves from the gardens and groves of the nineteenth century into the midst of a carboniferous jungle on the delta of some forgotten Amazon or some primeval Nile, we should find ourselves surrounded by strange and somewhat monotonous scenery, very different from that of the varied and beautiful world in which we ourselves now live. The huge foliage of gigantic tree-ferns and titanic club-mosses would wave over our heads, while a green carpet of petty trailing creepers would spread luxuriantly over the damp soil beneath our feet. Great swampy flats would stretch around us on every side; and, instead of the rocky or undulat-

ing hills of our familiar Europe, we should probably see the interior country composed only of low ridges, unlifted as yet by the slow upheaval of ages into the Alps or Pyrenees of the modern continent. But the most striking peculiarity of the scene would doubtless be the wearisome uniformity of its prevailing colors. Earth beneath and primitive trees overhead would all alike present a single field of unbroken and unvarying green. No scarlet flower, golden fruit, or gay butterfly would give a gleam of brighter and warmer coloring to the continuous verdure of that more than tropical forest. Green, and green, and green, again; wherever the eye fell it would rest alike upon one monotonous and unrelieved mass of harsh and angular verdure.

On the other hand, if we turn to a modern English meadow, we find it bright with yellow buttercups and purple clover, pink-tipped daisies and pale-faced primroses. We see the hedges white with may or glowing with dog-roses. We find the trees overhead covered with apple-blossom or scented with horse-chestnut. While in and out among the beautiful flowers flit equally beautiful butterflies—emperors, admirals, peacocks, orange-tips, and painted ladies. The green of the grassy meadow and the blue of the open sky serve only as backgrounds to show off the brighter hues of the beautiful blossoms and the insects that pay court to them incessantly.

To what is this great change in the general aspect of nature due? Almost entirely, we may now confidently conclude, to the color-sense in the insects themselves. The lovely tints of the summer flowers and the exquisite patterns on the butterfly's wings have alike been developed through the taste and the selective action of these humble little creatures. To trace up the gradual evolution of the insect color-sense and its subsequent reactions upon the outer world, we must go back to a time when neither flower nor butterfly yet existed.

In the carboniferous earth we have reason to believe that almost all the vegetation belonged to the flowerless type—the type now represented among us by ferns and horse-tails. These plants, as everybody knows, have no flowers, but only spores or naked frondlets. There were a few flowering plants it is true, in the carboniferous world, but they belonged entirely to the group of conifers, trees like the pines and cycads, which bear their seeds in cones, and whose flowers would only be recognized as such by a technical botanist. Even if some stray archaic members of the true flowering groups already existed, it is, at any rate, almost certain that they must have been devoid of those gay petals which distinguish the beautiful modern blossoms in our fields and gardens.

A flower, of course, consists essentially of a pistil or seed-producing organ, and a certain number of stamens or fertilizers. No seed can come to maturity unless fertilized by pollen from a stamen. But experience, and more especially the experiments of Mr. Darwin, have

shown that plants produced from the pollen of one flower applied to the pistil of another are stronger and more vigorous than plants produced from the stamens and ovules of a single blossom. It was to obtain the benefit of this cross-fertilization in a simple form that flowers first began to exist; their subsequent development depends upon the further extension of the same principle.

The pines and other conifers, the grasses and sedges, and the forest-trees, for the most part depend upon the wind to waft the pollen of one blossom to the pistil of the next. Hence their flowers generally protrude in great hanging masses, so that the breeze may easily carry off the pollen, and that the pistils may stand a fair chance of catching any passing grain. Flowers of some such types as these were doubtless the earliest of all to be evolved, and their colors are always either green or plain brown.

But wind-fertilization is very wasteful. Pollen is an expensive product to the plant, requiring much useful material for its manufacture; and yet it has to be turned loose in immense quantities on the chance that a stray grain here and there may light upon a pistil ready for its reception. It is almost as though the American farmers were to throw their corn into the Atlantic in hopes that a bushel or two might happen to be washed ashore in England by the waves and the Gulf Stream. Under such circumstances, a ship becomes of immense importance; and Nature has provided just such ships, ready-made for the very work that was crying out to them. These ships were the yet undifferentiated insects, whose descendants were to grow into bees, rose-beetles, and butterflies.

Already, in the carboniferous world, winged insects had begun to exist. Some of these must soon have taken to feeding among the hanging blossoms of the first flowering plants. Insects are fond of the soft and nutritious pollen; and it would seem at first sight as though they could therefore be only enemies to the plants which they visited. But, as they went from flower to flower in search of food, they would carry pollen from one to the other, clinging to their heads, feet, or legs; and so would unconsciously aid in fertilizing the blossoms. Though some of the pollen would thus be eaten up, yet the saving effected by the substitution of the insect as a ship, for the old wasteful mode of dispersal by the wind, would more than compensate for the loss thus brought about. Accordingly, it would naturally happen that those flowers which most specialized themselves for fertilization by means of insects, would gain a considerable advantage over their neighbors in the struggle for existence. For this purpose, their outer leaves ought to assume a cup-like shape, instead of the open clusters of the wind-fertilized type; and their form should be directed rather to saving the pollen than to exposing it; while their efforts must chiefly be expended in attracting the insects whose visits would benefit them, and repelling all others. Those flowers which

chanced to vary most in these directions would best succeed from generation to generation; and their descendants would finally become so modified as to be fitted for fertilization by insects only.

It would be needless here to allude once more to the changes in shape and arrangement thus brought about by the action of the insects. The attraction of perfume and honey, the devices of adaptation and modification, by which plants allure or detain their insect visitors, must be taken for granted, and we must pass on to our proper subject of color.

If, when insects were first beginning to visit flowers, there was any special difference by which the pollen-bearing parts could be easily distinguished from the other organs of the plant, we may be sure that it would be seized upon by the insects as a guide to the existence of food, and would so be further strengthened and developed in all future plants of the same species. Now, we have reason to believe that just such a primitive difference *does* exist between flowers, and leaves or stems; and *that* difference is one of color. Even if we look at the catkins and grass-blossoms of our own day, we see that they differ slightly in hue from the foliage of their respective plants. But it seems not improbable that color may have appeared much more frequently and abundantly in *primitive* wind-fertilized flowers than in those of our own epoch; because wind-fertilized flowers are only injured by the visits of insects, which would be attracted by bright color; and hence natural selection would tend to keep down the development of brilliant tints in them, as soon as these had become the recognized guides of the insect eye. In other words, as flowers have now split up, functionally speaking, into two great groups, the wind-fertilized and the insect-fertilized, any primitive tendency toward the production of bright leaves around the floral organs will have been steadily repressed in the one group and steadily encouraged in the other.

Did such a primitive tendency ever exist? In all probability, yes. The green parts of plants contain the special coloring-matter known as chlorophyl, which is essential to their action in deoxidizing the carbonic acid of the atmosphere. But, wherever fresh energies are being put forth, the reverse process of oxidation is going on; and in this reverse process the most brilliant and beautiful colors make their appearance. We are all familiar with these colors in autumn leaves; and we may also observe them very conspicuously in all young shoots or growing branches, especially in the opening buds of spring, the blanched heads of rhubarb or seakale, and the long sprays of a sprouting potato, grown in a dark cellar. Now, the neighborhood of the floral organs is just such a place where energies are being used up and where color is therefore likely to appear. Mr. Sorby has shown that the pigment in petals is often exactly the same as that in the very young red and yellow leaves of early spring, and the crimson foliage

of autumn, in the same plant. It would be impossible to go fully here into the evidence which might be offered on this head; an immense mass of facts shows us that color is always tending to appear in the leaves which immediately surround the floral organs; and that this tendency has been strengthened by insect selection of the most conspicuous blossoms, until it has finally resulted in the brilliant corollas of such flowers as those which we now cultivate in our modern gardens.

But all this takes for granted the very fact with which we are now concerned, the existence and growth of an insect color-sense. How do we know that insects can distinguish colors at all? For otherwise all this argument must be fallacious, and the presence of bright corollas must be due to some other cause.

Of all insects, bees are the most confirmed flower-haunters, and they have undergone the greatest modification in relation to their visits in search of honey. We might expect, therefore, that bees would exhibit a distinct color-sense; and this is actually the case. Sir John Lubbock's experiments clearly prove that bees possess the power of distinguishing between red, blue, green, and yellow. Being anxious to see whether insects were really attracted by the hues of flowers, he placed slips of glass, smeared with honey, on paper of various colors; and the bees upon which he experimented soon learned to return to one particular color only, even though both the paper and the honey were occasionally transposed. Thus we have direct evidence of the clearest sort that the higher insects *do* actually perceive the difference between various colors. Nay, more, their perception in this respect appears to be closely analogous to our own; for while the bees had no difficulty in discriminating between red, orange, or yellow, and green, they did not seem to perceive so marked a distinction between green and blue. Now, this fact is very like that which we perceive to hold good with the human eye, for all of us are much more likely to confuse green and blue than any two other hues.

If, then, bees and wasps, as Sir John Lubbock has shown, and butterflies, as we may infer from other observations, *do* possess this developed color-sense, we may ask, how did they obtain it? In all probability it grew up side by side with the growth of bright-hued flowers. Just as those blossoms which exhibited the greatest tendency to display a brilliant whorl of tinted leaves, in the neighborhood of their stamens and pistils, would best succeed in attracting insects, so, in return, those insects whose eyes were most adapted for distinguishing the pink and yellow blossoms from the green foliage would best succeed in procuring food, and would thus live down their less gifted competitors.

It may reasonably be asked, How could an animal without a color-sense develop such a faculty by the aid of natural selection alone? At first sight the question seems indeed a difficult one; but it is pos-

sible, I think, to suggest a way in which it may have happened. Colors, viewed objectively, consist of ether-waves having different rates of vibration. In an eye devoid of the color-sense, all these ether-waves would doubtless set up the same sort of action in all the ends of the nerves, and would therefore produce exactly the same general sensations. But if in certain eyes there was the slightest tendency for some of the nerve-terminals to respond specially to the oscillations of one particular order, while others of the nerve-terminals responded rather to oscillations of a different order, there would be the first groundwork for the evolution of a color-sense. If this diversity of action in the nerve-ends proved of no service to the animal, it would go no further, because those individuals who possessed it would not be favored beyond those who did not. But if it proved useful, as it undoubtedly would do to flower-haunting insects, natural selection would insure its survival and its constant increase from generation to generation. Even color-blind people among ourselves can be taught by care and attention to discriminate slightly between the hues which they at first confuse; and if we were to choose out, time after time, from a color-blind race, all those individuals who were best able to see these distinctions, we should, no doubt, at last succeed in producing a perfect color-sense. This is just what natural selection seems to have done in the case of bees and butterflies.

Yet it may be urged that insects perhaps had a color-sense *before* they began to haunt flowers, and that this sense enabled them to pick out the brighter blossoms from the very beginning. Such an hypothesis would make the origin of beautiful flowers a much more simple matter; but we can hardly accept it, for a very good reason. Before the existence of flowers there was probably nothing upon which insects could exert a color-sense. Now, we know that no faculty ever comes into existence until it is practically of use to its possessors. Thus, animals which always live fixed and immovable in one place never develop eyes, because eyes would be quite useless to them; and even those creatures which possess organs of vision in their young and free state lose them as soon as they settle down for life in a permanent and unchangeable home. So, unless insects had something to gain by possessing a color-sense, they could never get one, prophetically, so to speak, against the contingency of flowers at some time or other appearing. Of course, no creature would develop such a sense merely for the sake of admiring the rainbow and the sunset, or of observing gems and shells or other such bright-hued but useless bodies. It is in the insect's practical world of food-hunting and flower-seeking that we must look for the original impulse of the color-sense.

Again, throughout the whole animal world, we see good reasons for concluding that, as a matter of fact, and apart from such deductive reasoning, only those species exhibit evident signs of a color-sense to whom its possession would be an undoubted advantage. Thus, in this

very class of insects, bees, as Sir John Lubbock's experiments show us, do undoubtedly distinguish between red, orange, yellow, and green. Butterflies also are attracted by colors, and will, in particular, fly down to objects of the same hue as their own mates. Of course, bees and butterflies, always living among flowers, especially require a good sense of color; and so they quite accord with our expectation. Wasps, again, are omnivorous creatures, living partly upon animal and partly upon vegetable food. Everybody knows that they will quite impartially feast upon a piece of raw meat or upon the sunny side of a peach. Now, wasps, as Sir John Lubbock proved, can also distinguish colors; but they are somewhat less guided by them, apparently, than are bees; and this again bears out the same generalization. Ants are much more miscellaneous in their diet, they have no wings (roughly speaking), and they do not visit flowers except by the casual process of walking up the stems. Hence a color-sense would be of little or no use to them: and Sir John Lubbock's experiments seem to show that they scarcely possess one, or only possess it in a rudimentary form. Once more, moths fly about in the dusk, or quite at night, and the flowers which lay themselves out to attract them are white or pale yellow, since no others are visible in the evening. Thus a perception of red, blue, or orange would probably be useless to them: and Mr. Lowne has shown that the eyes of nocturnal insects differ from those of diurnal insects in a way closely analogous to that in which the eyes of bats and owls differ from those of monkeys and humming-birds. These differences are probably connected in both cases with an absence of special organs for discriminating colors; and we shall see a little later on that, while the day-flying butterflies are decked in crimson and orange to please the eyes of their fastidious mates, the night-flying moths are mostly dull and dingy in hue, or reflect the light only in the same manner as the night-flowering blossoms among which they seek their food. Ascending to the vertebrates, the birds are the class which live most in a world of fruits or flowers; and Mr. A. R. Wallace has pointed out that birds on the whole need to perceive color more than any other animals, because their habits require that they should recognize their food at a considerable distance. But birds possess a very large proportion of certain nerve-terminals called the cones, which are three times as numerous in their eyes as the other kind, called rods. These cones are almost universally believed to be the special organs of color-perception, and in mammals they are actually *less* numerous than the rods, which are supposed to be merely cognizant of light and shade. Nocturnal birds, such as owls, have very few cones, while nocturnal mammals have none. Again, the yellow spot in the retina, consisting almost entirely of cones, is found in all diurnal birds; but among mammals it occurs only in the fruit-eating class of monkeys, and in man. So that on the whole we may say the positive evidence justifies us in believing that a highly-developed

color-sense exists only in those animals which would be decidedly benefited by its possession. And for these reasons it seems improbable that insects ever developed such a faculty until the need for it arose among the beautiful flowers.

Now that we have arrived at this theoretical conclusion, let us hark back again for a while to the reactions which the color-sense, thus aroused, produced upon the flowers which gave it birth.

We may take, as a capital example of an insect-fertilized flower, an English dog-rose. Compare this mentally with the wind-fertilized blossoms, such as grasses and catkins, and it is at once obvious that the great difference between them consists in the presence of a colored corolla. No wind-fertilized plant ever has a whorl of gay petals; and though the converse is not quite true, yet almost all insect-fertilized plants are noticeable for their brilliant tints of red, white, blue, or yellow. The structures in which these pigments reside have no function whatsoever, except that of attracting the insect eye. They are produced by the plant at an enormous physiological expense; and, if their object were not to secure the visits of insects, they would be just so much dead loss to the species. Nor is it only once that these colored corollas have been developed. They occur, quite independently, in both great divisions of flowering plants, the monocotyledons and the dicotyledons. This coincidence could hardly have happened had it not been for that original tendency which we already noticed for pink, scarlet, or orange pigments to appear in the neighborhood of the floral organs. Nor is it twice only, in all probability, that flowers have acquired bright petals through insect visits, but a thousand times over. In almost every family, insect-fertilized, self-fertilized, and wind-fertilized species are found side by side, the one with brilliant petals, the others with small, green, and inconspicuous flowers.

For comparison with the dog-rose, one could not find a better type than that common little early spring blossom, the dog's mercury. It is a wind-fertilized flower, and it does not wish to be seen of insects. Now, this mercury is a very instructive example of a degenerate green flower. For, apparently, it is descended from an insect-fertilized ancestor with bright petals; but, owing to some special cause, it has taken once more to the old wasteful habit of tossing its pollen to the wandering winds. As a consequence it has lost the bright corolla, and now retains only three green and unnoticeable perianth-pieces, no doubt the representatives of its original calyx. Almost equally instructive is the case of the groundsel, though in this case the process of degradation has not gone quite so far. Groundsel is a degenerate composite, far gone on the way of self-fertilization. No class of flowers have been more highly modified to suit the visits of insects than the composites. Hundreds of their tubular bells have been crowded on to a single head, so as to make the greatest possible attractive display; and in many cases the outer blossoms of the head, as in the

common yellow ragwort, or in the daisy and the sunflower, have been flattened out into long rays, which serve as pennants or banners to catch the insect eye. They are very successful flowers, perhaps the most successful family on the whole earth. But the groundsel, for some reason of its own, has reversed the general family policy. It is rarely visited by insects, and has, therefore, apparently taken once more to self-fertilization; and a complete alteration has thus been effected in its appearance, when compared with its sister composites. Though it has not yet quite lost its yellow center blossoms, it has no rays, and its bells are almost concealed by its large and ugly green involucre. Altogether, we may say that groundsel is a composite far advanced on its way to a complete loss of the characteristic composite habits. It still receives the visits of a very few stray insects; but it does not lay itself out to court them, and it is, probably, gradually losing more and more of its winged clients from day to day. Thus we see that any flower which will benefit by insect-fertilization, whether it be a monocotyledon or a dicotyledon, high up or low down in either series, is almost sure to acquire brilliant petals; while, on the other hand, any flower which gives up the habit of relying upon insects is almost sure to lose or minimize its petals once more, and return to a state resembling in general type the catkins and grasses or the still lowlier self-fertilized types.

The same sort of conclusion is forced upon us if we look at the various organs in each flower which display the brilliant pigments. The petals are most commonly the seat of the attractive coloration, as in the dog-rose and the marsh-mallow. But in many other flowers, like the fuchsia, the calyx is also beautifully colored, so as to aid in the general display. In the tulips and other lilies, the crocus, the iris, and the daffodil, sepals and petals are all colored alike. In marvel-of-Peru and purple clematis, the petals are wholly wanting. In the common meadow-rue, it is the essential floral organs themselves which act as allurements; while, in the mesembryanthemums, the outer stamens become flattened and petal-like, so as to resemble the corolla of other flowers. In the composites, like daisies, where many blossoms are crowded on one head, the outer row of blossoms is often similarly flattened into rays which only serve the purpose of attracting insects toward the fertile flowers of the center. Nor does the coloring process stop at the regular parts of the flower alone: the neighboring bracts and leaves are often even more beautifully tinted than the flowers themselves. In the great white arums, grown in windows as Ethiopian lilies, the actual blossoms lie right inside the big sheath or spathe, and cluster round the tall yellow spike or spadix in the center: and this sheath acts the part of petals in the more ordinary flowers. Many euphorbias have very inconspicuous little blossoms, but each small colony is surrounded by a scarlet involucre which makes them some of the gayest among our hot-house plants. The poinsettia,

which is so familiar a fashionable dinner-table plant, bears little yellow flowers which would not of themselves attract the eyes of insects; but it makes up for this deficiency by a large surrounding bunch of the richest crimson leaves, whose gorgeous coloring makes the tree a universal favorite with tropical bees and butterflies. The lovely bougainvillea carries the same idea one step further, for its small flowers are inclosed by three regularly arranged bracts of a delicate mauve or pink; and, when one sees a tree covered with this magnificent creeper in full blossom, it forms one of the most glorious masses of color to be found in the whole of external nature. Many tropical plants, and especially those of parasitical habit, are much given to developing these extra allurements of colored leaves, and their general effect is usually one of extreme brilliancy. From all these examples, we can draw the conclusion that color does not belong by original nature to one part of the plant rather than another; but that wherever the colored juices which result from oxidation of chlorophyl and its analogues began to show themselves, in the neighborhood of the stamens and pistil, they would attract the attention of insects, and so grow more and more prominent, through natural selection, from generation to generation, till they finally attained the present beauty of the tulip, the rose, the poinsettia, and the bougainvillea.

From this marvelous reaction of the color-sense in insects upon the vegetal world we must next pass on to its reaction upon the hues of insects themselves. For we probably owe the exquisite wings of the butterfly and the gorgeous burnished bronze of the rose-beetle to the very same sense and the very same selective action which have produced the hues of the lily and the hyacinth. What proofs can be shown that the colors of insects are thus due to sexual selection? In the first place, we have the certain fact that bees at least, and probably other insects, do distinguish and remember colors. Not only so, but their tendency to follow color has been strong enough to produce all the beautiful blossoms of our fields and gardens. Moreover, we have seen that while bees, which are flower-haunters, are guided greatly by color, wasps, which are omnivorous, are guided to a less extent, and ants, which are very miscellaneous feeders, not at all. It may be objected that insects do not care for the color apart from the amount of honey; but Mr. Anderson noticed that, when the corollas of certain flowers had been cut away, the insects never discovered or visited the flowers; and Mr. Darwin lopped off the big lower petals of several lobelia-blossoms, and found that the bees never noticed them, though they constantly visited the neighboring flowers. On the other hand, many bright-colored bells have no honey, but merely make a great show for nothing, and so deceive insects into paying them a call on the delusive expectation that they will be asked to stay to dinner. Some very unprincipled flowers, like the huge Sumatran rafflesia, thus take in the carrion-flies, by resembling in smell and appearance a

piece of decaying meat. Moreover, certain insects show a preference for certain special flowers over others. One may watch for hours the visits paid by a bee or a butterfly to several dozens of one flower, say a purple lamium, in succession, passing by unnoticed the white or yellow blossoms which intervene between them. Fritz Müller mentions an interesting case of a lantana, which is yellow on the first day, orange on the second, and purple on the third. "This plant," he says, "is visited by various butterflies. As far as I have seen, the purple blossoms are never touched. Some species inserted their probosces both into yellow and into orange flowers; others, as far as I have observed, exclusively into the yellow flowers of the first day." Mr. T. D. Lilly, an American naturalist, observed that the colored petunias and morning-glories in his garden were torn to pieces by bees and butterflies in getting at the honey, while the white or pale ones were never visited. These are only a few sample cases out of hundreds, in which various observers have noted the preference shown by insects for blossoms of a special color.

Again, we may ask, Do different species of insects show different degrees of æsthetic taste? The late Dr. Hermann Müller, who specially devoted himself to the relations between insects and flowers, showed most conclusively that they do. The butterflies, which are at once the most locomotive and most beautiful of their class, appear to require larger masses of color for their attraction than any other group; and the flowers which depend upon them for fertilization are, in consequence, exceptionally large and brilliant. Müller attributes to this cause the well-known beauty of Alpine flowers, because bees and flies are comparatively rare among the higher Alps, while butterflies, which rise to greater elevations in the air, are comparatively common; and he has shown that, in many cases, where a lowland flower is adapted for fertilization by bees, and has a small or inconspicuous blossom, its Alpine congener has been modified so as to be suited for fertilization by butterflies, and has, therefore, brilliant bunches of crimson or purple blossoms. In his last work, he shows that, while bees form as many as seventy-five per cent of the insects visiting the beautiful and attractive composites, they form only fourteen per cent of those which visit the plain green and white umbellates, like the wild-carrot and fool's-parsley. Butterflies frequently visit the composites, but almost never the umbellates, which last depend mainly upon the smaller flies and other like insects. Of two small hedge-flowers (*Galium mollugo* and *G. verum*), Müller notes that they agree closely in other points, but the first is white, while the second is yellow, which, he says, renders it more attractive to small beetles. Of certain other flowers, which lay themselves out to attract wasps, Müller quaintly observes that they are obviously adapted "to a less æsthetically cultivated circle of acquaintances." So that the close studies of this accurate and painstaking naturalist led him to the conclusion that

insects differ greatly from one another in their taste for color. Probably we shall be right if we say that the most æsthetic among them all are the butterflies, and next the bees—these two classes having undergone the most profound modifications in adaptation to their flower-haunting life—and that the carrion-flies and wasps bring up the rear.

Is there any evidence, however, that insects ever notice color in anything else but flowers? Do they notice it in their own mates, and use it as a means of recognition? Apparently they do, for Mr. Doubleday informed Mr. Darwin that white butterflies often fly down to pieces of white paper on the ground, mistaking them doubtless for others of their species. So, too, Mr. Collingwood notes that a red butterfly, let us say, nailed to a twig, will attract other red butterflies of the same kind, or a yellow one its yellow congeners. When many butterflies of allied species inhabit the same district, it often happens that the various kinds undergo remarkable variation in their coloring so as to be readily recognizable by their own mates. Again, Mr. Patterson noticed that certain blue dragon-flies settled in numbers on the blue float of a fishing-line, while two other species were attracted by shining white colors. On the whole, it seems probable that all insects possessing the color-sense possess also a certain æsthetic taste for colors.

Indeed, it is difficult to see how it could be otherwise. Whenever an animal exercises a faculty much, the exercise comes to have pleasant feelings attached to it; and this is especially the case with all sense-organs. Creatures which live on honey love sweet things: carnivores delight in the taste of blood. Singing birds listen with interest to musical notes: and even insects will chirp in response to a chirp like their own. So, creatures which pass all their lives in the search for bright flowers must almost inevitably come to feel pleasure in the perception of brilliant colors. This is not, as so many people seem to think, a question of relative intellectual organization: it is a mere question of the presence or absence of certain sense-centers.

But it may finally be urged that, even though insects recognize and admire colors in the mass, they would not notice such minute and delicate patterns as those on their own wings. Let us see what evidence we can collect on this head. First of all, insects have not only produced the petals of flowers, but also the special markings on those petals. Now, these markings, as Sprengel pointed out a century since, bear a constant reference to the position of the honey, and are in fact regular honey-guides. If one examines any flower with such marks upon the petals, it will be found that they converge in the direction of the nectaries, and show the bee or butterfly whereabout he may look for his dinner. Accordingly, they must have been developed by the gradual action of insects in fertilizing most frequently those flowers which offered them the easiest indication of where to go for food. Unless insects noticed them, nay more, noticed them closely and accu-

rately, they could never have grown to their present definite correlation with the nectary, a correlation which, Mr. Darwin says, first convinced him of the reality of their function. "I did not realize the importance of these guiding marks," says Sir John Lubbock, "until, by experiments on bees, I saw how much time they lose if honey which is put out for them is moved even slightly from its usual place." In short, insects, like men, are creatures of habit. How complicated these marks sometimes become, we can see in most orchids.

Again, the attention insects pay to comparatively small details of color and form is clear enough from the *mimicry* which sometimes occurs among them. In some instances, the mimicry is intended to deceive the eyes of higher animals, such as birds or lizards, and can therefore prove nothing with regard to the senses of the insects themselves. But, in a few cases, the disguise is adopted for the sake of deceiving other insects; and the closeness of the resemblance may be accepted as good evidence of acute vision in the class so mimicked. Thus, several species of flies live as social parasites among the hives or nests of bees. These flies have acquired belts of color and patches of hair, closely imitating the hosts whose honey they steal; while their larvæ have even the ingratitude to devour the larvæ of the bees themselves. Of course, any fly who entered a bee-hive could only escape detection and condign punishment at the hands—or rather at the stings—of its inhabitants, provided it looked so like the householders as to be mistaken by them for one of the community. So any fly which showed at first any resemblance to a bee would for a while be enabled to rob with impunity: but, as time went on, the bees would begin to perceive the true nature of the intruders, and would kill all those which could be readily distinguished. Thus, only the most bee-like flies would finally survive; and the extent to which the mimicry was carried would be a rough test of the perceptive powers of the bees. Now, in these particular cases, the resemblance is so close that it would take in, not only an unpracticed human observer, but even for a moment the entomologist himself. Similar instances occur among *Mantidæ* and crickets.

And now let us apply these facts to the consideration of the problem before us. If those insects which especially haunt flowers are likely to have so acquired a color-sense and a taste for colors, and if they are capable of observing minute markings, bands, or eye-like spots, then we might naturally infer that they would exhibit a preference for the most beautifully colored and variously ornamented of their own mates. Such a preference, long continued and handed down to after-generations, would finally result in the development of very beautiful and varied colors among the flower-haunting species. We might expect, therefore, to find the most exquisite insects among those races which are most fully adapted to a diet of honey and pollen; and such I believe to be actually the case.

Before proceeding further, precautions should be taken against a misconception which has already occurred in this connection. It is not meant that bright colors will be found *only* among flower-haunters; for it may easily happen that in a few instances other causes may conspire to produce brilliant hues. Nor is it meant that *all* flower-haunters are necessarily brilliant; for it may also happen that some special need of protection will occasionally keep down the production of conspicuous tints. But what *is* meant is that brilliant colors are found with very exceptional frequency among the specially flower-haunting animals.

Butterflies are the order of insects which require the largest mass of color to attract them, and which seem to possess the highest æsthetic sensibility. It is hardly necessary to say that butterflies are also the most beautiful of all insects; and are, moreover, noticeable for the most highly developed ornamental adjuncts. Those butterflies make the best matches in their world of fashion which have the brightest crimson on their wings or the most exquisite gloss in their changeful golden scales. With us, an eligible young man is too often a young man with a handsome estate in the country, and with no other attractions mental or physical. Among insects, which have no estates, an eligible young butterfly is one with a peculiarly deep and rich orange band upon the tip of his wings. Thus the cumulative proof of the æsthetic superiority of butterflies seems well-nigh complete.

If we examine the lepidoptera or butterfly order in detail, we shall find some striking conclusions of the same sort forced upon us. The lepidoptera are divided into two great groups, the moths and the butterflies. Now, the moths fly about in the dusk or late at night; the flowers which attract them are pale, lacking in brilliancy, and, above all, destitute of honey-guides in the shape of lines or spots; and the insects themselves are generally dark and dingy in coloration. Whenever they possess any beauty of color, it takes the form of silvery scales which reflect what little light there may be in the gray gloaming. The butterflies, on the other hand, fly by day, and display, as we know, the most beautiful colors of all insects. Here we must once more recall that difference between the structure of the eye in nocturnal and diurnal species which Mr. Lowne has pointed out. Nor is this all. While most moths are night-fliers, there are a few tropical genera which have taken to the same open daylight existence as the butterflies. In these cases, the moths, unlike their nocturnal congeners, are clad in the most gorgeous possible mixtures of brilliant metallic colors.

Other instances of like kind occur in other orders. Thus, among the beetles, there is one family, the rose-chafers, which has been specialized for flower-haunting; and these are conspicuous for the beauty of their coloring, including a vast number of the most brilliant exotic species. Their allies, the common cock-chafers, however, which are not specialized in the same manner, are mere black and inconspicuous

insects. So among the flies: most of the omnivorous families are dull and ugly; but several of the flower-haunting tribes are adorned with brilliant colors, and live upon honey. In fact, an immense majority of the brightest insects are honey-suckers, and seem to have derived their taste for beautiful hues from the nature of the objects among which they seek their food.

There is one striking and obvious exception, however, which has doubtless already suggested itself to the minds of readers. I mean the bees. These are the most flower-loving of all insects, and yet they are comparatively plain in their coloration. We must remember, however, that the peculiar nature of the commonwealth among the social bees prevents the free action of the selective preference by which we account for the brilliancy of all other flower-haunting species. The queen or mother bee is a prisoner for life; her Majesty's domestic arrangements are all made for her by the state; she does not herself seek honey among flowers, and those bees which do so have no power of transmitting their tastes to descendants, as they live and die mere household drudges. On the other hand, the solitary bees are in many cases exquisitely colored, as we might expect from their power of free choice; and one flower-haunting family of the same order, the *Chrysidæ*, are aptly compared to the humming-birds in the richness of their coloring.

One more peculiarity of great interest must also be noted. It appears that many insects have two sets of colors, seemingly for different purposes; the one set protective from the attacks of enemies, the other set attractive to their own mates. Thus several butterflies have the lower side of their wings colored like the leaves or bark on which they rest, while the upper sides are rich with crimson, orange, and gold, which gleam in the bright sunlight as they flit about among their fellows. Butterflies, of course, fold their wings with the under side outward. On the other hand, moths, which fold their wings in the opposite manner, often have their upper surfaces imitative or protective, while the lower sides are bright and beautiful. One Malayan butterfly, the *Kallima paralecta*, has wings of purple and orange above, but it exactly mimics dead foliage when its vans are folded; and, as it always rests among dry leaves, it can hardly be distinguished from them, as it is even apparently spotted with small fungi. In these and many other cases one can not help believing that, while imitative coloring has been acquired for protective purposes, the bright hues of the concealed portion must be similarly useful to the insect as a personal decoration.

It would seem, then, that we owe half the loveliest objects in our modern world to the insect color-sense. It is the bee and the butterfly which have given us the gorgeous orchids and massive creepers of the tropics, the gentians and rhododendrons of the Alps, the camellias and heathers of our conservatories, the may and primroses of our

English meadows. To the same primitive taste, exerted in a slightly different direction, are due the gilded wings of Brazilian moths, and the exquisite tints of our own ruby or sapphire colored summer insects. The beauty and the glory of the world are not for the eyes of man alone; they appeal equally to the bee and the butterfly, to the bird and the child. To some people it strangely seems a nobler belief that one animal only out of all the earth enjoys and appreciates this perpetual pageant of natural loveliness; to me it appears, on the contrary, a prettier and more modest creed, as well as a truer one, that in those higher and purer delights we are but participants with the vast mass of our humbler dumb fellow-creatures.—*Gentleman's Magazine.*

THE FRUITS OF MANUAL TRAINING.

By Professor C. M. WOODWARD, Ph. D.,
WASHINGTON UNIVERSITY, ST. LOUIS.

THE object of this paper is to consider directly the fruits of manual training. By manual training I do not mean merely the training of the hand and arm. If a school should attempt the very narrow task of teaching only the manual details of a particular trade or trades, it would, as Felix Adler says, violate the rights of the children. It would be doing the very thing I have always protested against. That, or very nearly that, is what is done in the great majority of European trade-schools. They have no place in our American system of education.

The word "manual" must, for the present, be the best word to distinguish that peculiar system of liberal education which recognizes the manual as well as the intellectual. I advocate manual training for all children as an element in general education. I care little what tools are used, or how they are used, so long as proper habits (morals) are formed, and provided the windows of the mind are kept open toward the world of *things* and *forces*, physical as well as spiritual.

We do not wish or propose to neglect or underrate literary and scientific culture; we strive to include all the elements in just proportion. When the manual elements which are essential to a liberal education are universally accepted and incorporated into American schools, the word "manual" may very properly be dropped.

I use the word "liberal" in its strict sense of "free." No education can be "free" which leaves the child no choice, or which gives a bias against any honorable occupation; which walls up the avenues of approach to any vocation requiring intelligence and skill. A truly liberal education educates equally for all spheres of usefulness; it furnishes the broad foundation on which to build the superstructure

of a happy, useful, and successful life. To be sure, this claim has been made for the old education, but, the claim is not allowed. The new education has the missing features all supplied. The old education was like a two-legged stool, it lacked stability; the new education stands squarely on three legs, and it is steady on the roughest ground.

I shall be better understood if I briefly outline my idea of the features of a manual-training school: Boys from fourteen to eighteen years of age are admitted on examination. The grade is about that of a high-school. The course covers three years. The programme of every day includes three recitations (mathematics, language, and science), one hour of drawing, and two hours of shop-work—making a session, exclusive of lunch-time, of six hours. The order in which these exercises come varies in different divisions. The shops and shop-instructors are generally occupied during school-hours. In each subject taught the instruction is progressive and thorough. Mathematics begins with arithmetic and ends with trigonometry. Language may be English literature and composition, history and political economy; or Latin, or French. Science, beginning with Huxley's "Introductory Primer," runs through botany, physical geography, elementary physics, mechanics, and chemistry. Drawing is free-hand and mechanical, projection and "model," geometric, technical, and ornamental.

The shop-work runs impartially through the range of bench, lathe, and pattern work in wood; forging, brazing, and soldering metals; bench, lathe, planer, and drill work in iron, brass, and steel. The aim is to make every exercise in every branch disciplinary—intellectually and morally fruitful. With the exception of the choice of Latin and French, there is no option in the course.

I claim as the fruits of manual training, when combined, as it always should be, with generous mental and moral training, the following:

1. Larger classes of boys in the grammar and high schools; 2. Better intellectual development; 3. A more wholesome moral education; 4. Sounder judgments of men and things, and of living issues; 5. Better choice of occupations; 6. A higher degree of material success, individual and social; 7. The elevation of many of the occupations from the realm of brute, unintelligent labor, to one requiring and rewarding cultivation and skill; 8. The solution of "labor" problems. I shall touch briefly on each of these points:

1. Boys will stay in School longer than they do now.—Every one knows how classes of boys diminish as they approach and pass through the high-school. The deserters scale the walls and break for the shelter of active life. The drill is unattractive, and, so far as they can see, of comparatively little value. There is a wide conviction of the inutility of schooling for the great mass of children beyond the primary grades, and this conviction is not limited to any class or grade

of intelligence. Wage-workers we must have, and the graduates of the higher grades are not expected to be wage-workers. According to the report of the President of the Chicago School Board, about one and one eighth per cent of the boys in the public schools are in the high-schools. From his figures it appears that, if every boy in the Chicago public schools should extend his schooling through a high-school, the four classes of the high-schools would contain some nine thousand boys; in point of fact, they have about four hundred.

Superintendent Hinsdale, of Cleveland, says, "Of one hundred and eight pupils (boys and girls) entering the primary school, sixty complete the primary, twenty finish the grammar, four are found in the second class of the high, and one graduates from the high-school." In St. Louis the average age at which pupils withdraw from the public schools is thirteen and a half years. Now, I doubt if any reflecting person would consider it an unmixed good if every boy in the city should go through the high-school as it is at present conducted. Under the circumstances supposed all would probably admit that some change in the character of the instruction would be necessary.

From the observed influence of manual training upon boys and indirectly upon the parents, I am led to claim that when the last year of the grammar and the high schools include manual training, they will meet a much wider demand; that the education they afford will be really more valuable; and, consequently, that the attendance of boys will be more than doubled. Add the manual elements with their freshness and variety, their delightful shop exercises, their healthy intellectual and moral atmosphere, and the living reality of their work, and *the boys will stay in school.* Such a result would be an unmixed good. I have seen boys doing well in a manual-training school who could not have been forced to attend an ordinary school. If the city of Boston shall carry out this year, as I hope it will, Superintendent Seaver's plan for a public manual-training school for three hundred boys, there will be, in my judgment, one thousand applications for admission during the first three years.

2. Better Intellectual Development.—I am met here with the objection that I am aiming at an impossibility; that, if I attempt to round out education by the introduction of manual training, to develop the creative or executive side, I shall certainly curtail it of elements more valuable still; that the educational cup is now full; and that, if I pour in my gross material notions on one side, some of the most precious intellectual fluid will certainly flow out on the other.

Now, I deny that the introduction of manual training does of necessity force out any essential feature of mental and moral culture. The cup may be, and probably is, full to overflowing, but it is a shriveled and one-sided cup. It is as sensitive and active in its own defense as are the walls of the stomach, which, when overfed with ill-assorted food, contracts, rebels, and overflows, but which expands and readily

digests generous rations of a varied diet. Did you ever see one whose mind was nauseated with spelling-books, lexicons, and grammars, and an endless hash of words and definitions? And did you, in such a case, call in the two doctors, Johann Pestalozzi and Friedrich Froebel? And did you watch the magic influence of a diet of *things* prescribed by the former, and a little vigorous practice in *doing*, in the place of *talking*, under the direction of the latter?

The students of a well-conducted manual-training school are intellectually as active and vigorous as in any high-school. Nay, more, I claim, and I have had good opportunity to observe the facts, that even on the intellectual side the manual-training boy has a decided advantage. I have been in charge of both kinds of school, and I know whereof I speak. The education of the hand is the means of more completely and efficaciously educating the brain. Manual dexterity is but the evidence of a certain kind of mental power; and this mental power, coupled with a familiarity with the tools the hands use, is doubtless the only basis of that sound, practical judgment and ready mastery of material forces which always characterize those well fitted for the duties of active, industrial life.

I go a step further. When the limit of sharp attention and lively interest is reached, you have reached the limit of profitable study. If you can hold the attention of a class but ten minutes, it is worse than a waste of time to make the exercise fifteen. The weary intellects roll themselves up in self-defense, and suffer as patiently as they can, but the memory of those moments of torment lingers and throws its dreadful shadow over the exercise as it comes up again on the morrow; and how automatically, as these over-taught children take their places again, do they begin to roll themselves up into an attitude of mental stupidity! Intellectual growth is not to be gauged by the length or number of the daily recitations. I firmly believe that in most of our schools there is too much sameness and monotony; too much intellectual weariness and consequent torpor. Hence, if we abridge somewhat the hours given to books, and introduce exercises of a widely different character, the result is a positive intellectual gain. There is plenty of time if you will but use it aright. Throw into the fire those modern instruments of mental torture—the spelling and defining books. Banish English grammar, and confine to reasonable limits geography and word-analysis. Take mathematics, literature, science, and art, in just proportion, and you will have time enough for drawing and the study of tools and mechanical methods.

Manual exercises, which are at the same time intellectual exercises, are highly attractive to healthy boys. If you doubt this, go into the shops of a manual-training school and see for yourselves. Go, for instance, into our forging-shop, where metals are wrought through the agency of heat. A score of young Vulcans, bare-armed, leather-aproned, with many a drop of honest sweat and other trade-marks of

toil, stand up to their anvils with an unconscious earnestness which shows how much they enjoy their work. What are they doing? They are using brains and hands. They are studying definitions, in the only dictionary which really defines the meaning of such words as "iron," "steel," "welding," "tempering," "upsetting," "chilling," etc. And, in the shop where metals are wrought cold (which, for want of a better name, we call our machine-shop), every new exercise is like a delightful trip into a new field of thought and investigation. Every exercise, if properly conducted, is both mental and manual. Every tool used and every process followed has its history, its genesis, and its evolution.

I have been speaking of the shops of the manual-training school, not of the ordinary factory. In the latter everything is reduced as much as possible to a dull routine. Intellectual life and activity are not aimed at. The sole object of the factory is the production of articles for the market. In a manual-training school, on the other hand, everything is for the benefit of the boy; he is the most important thing in the shop; *he is the only article to be put upon the market.* No one can learn from a book the true force of technical terms and definitions, nor the properties of materials. All descriptive words and names must base their meaning upon our own consciousness of the things they signify. The obscurities of the text-books (often doubly obscure from the lack of proper training on the part of the authors, who describe processes they never tried, and objects they never saw) vanish before the steady gaze of a boy whose hands and eyes have assisted in the building of mental images.

Then, again, the habit of clear-headedness, of precision in regard to the minor details of a subject, which is absolutely essential in the shop—an exact and experimental knowledge of the full force of the words and symbols used—stretches with its wholesome influence into the study of words and the structure of language. As Felix Adler says, the doing of one thing well is the beginning of doing all things well. I am a thorough disbeliever in the doctrine that it is ever educationally useful to commit to memory words which are not understood. The memory has its abundant uses, and should be carefully cultivated; but when it usurps the place of the understanding, when it beguiles the mind into the habit of accepting the images of words for the images of the things the words stand for, then the memory becomes a positive hindrance to intellectual development.

"Manual training is essential to the right and full development of the human mind, and therefore no less beneficial to those who are not going to become artisans than to those who are. . . . The workshop method of instruction is of great educational value, for it brings the learner face to face with the facts of nature; his mind increases in knowledge by direct personal experience with forms of matter and manifestations of force. No mere words intervene. The manual ex-

ercises of the shop train mental power rather than load the memory; *they fill the mind with the solid merchandise of knowledge, and not with its empty packing-cases.*"—(*Professor E. P. Seaver, Boston.*)

3. A MORE WHOLESOME MORAL EDUCATION.—The finest fruit of education is character; and the more complete and symmetrical, the more perfectly balanced the education, the choicer the fruit.

To begin with, I have noted the good effect of *occupation.* The programme of a manual-training school has something to interest and inspire every boy. The daily session is six full hours, but I have never found it too long. The school is not a bore, and holidays, except for the name of the thing, are unpopular. I have been forced to make strict rules to prevent the boys from crowding into the shops and drawing-rooms on Saturdays and after school-hours. There is little tendency, therefore, to stroll about, looking for excitement. The exercises of the day fill the mind with thoughts pleasant and profitable, at home and at night. A boy's natural passion for handling, fixing, and making things is systematically guided into channels instructive and useful, as parents freely relate.

Again, success in one branch or study (shop-exercises are marked like those of the recitation-room) encourages effort in others, and the methods of the shop affect the whole school. Gradually the students acquire two most valuable habits which are certain to influence their whole lives for good—namely, precision and method. As Professor Runkle says, "Whatever cultivates care, close observation, exactness, patience, and method, must be valuable training and preparation for all studies and all pursuits."

Dr. Adler has pointed out, with great force and elegance, the influence of the exercises of the shop upon the formation of character. This influence, he holds, will be "nothing short of revolutionary, inasmuch as it will help to overthrow many of the impure conceptions that prevail at the present day." The tasks we set are not to be judged by commercial standards; our standard is one hundred per cent; the articles we make are not to be sold; they have no pecuniary value; they are merely typical forms; their worth consists in being true, or in being beautiful, as the case may be.

The manual-training school, when well conducted, seems to me to furnish to its pupils just the opportunity which Walter Scott, in "Waverley," says that his young hero was losing forever—"the opportunity of acquiring habits of firm and assiduous application; of gaining the art of controlling, directing, and concentrating the powers of his mind for earnest investigation—an art far more essential than even that intimate acquaintance with classical learning which is the primary object of study" (at school).

4. SOUNDER JUDGMENTS OF MEN AND THINGS.—The proverbially poor judgments of scholars have led to the popular belief that theory is one thing and practice a very different thing; that theoretically a

thing is one way, practically another. The truth is, that correct theory and practice agree perfectly. If in his theory one leaves out a single element of the problem, or fails to give each its due weight, his theory is false. The school-men have been so accustomed to living in an ideal world, the world of books and books only, where they have found only ideal problems, and they have been so ignorant of the real world and the conditions of real problems, that their solutions have very generally been false.

A harmonious culture develops common sense, and common sense is at the basis of good judgment. We aim to raise that kind of fruit. Boys who put every theory to the practical test, who know something about what the idealists call "the total depravity of inanimate things," who probe and test every statement and appliance, with whom authority and tradition, the bane of too much "book-learning," have little influence, and who therefore are apt to take things at their true value, are fitted to focus correctly upon the problems of real life.

We hear much, and with good reason, of the value of directive intelligence. To be a director one must have good judgment. He who would successfully direct the labor of other men must first learn the art of successful labor himself; and he who would direct a machine properly must understand the principles of its construction, and be personally skilled in the arts of preservation and repair. Dr. Harris, therefore, tells but a half-truth when he says that "The new discovery (the invention of a new tool) will make the trade learned to-day, after a long and tedious apprenticeship, useless to-morrow. The practical education, therefore, is not an education of the hand to skill, but of the brain to directive intelligence. The educated man can learn to direct a new machine in three weeks, while *it requires three years to learn a new manual labor.*"—("Education," May–June, 1883.)

This last sentence is not clear to me. Somehow it seems to imply that the man who learns to run a machine should be more intelligent and requires more education than the man who made it. As to "directive intelligence," I respectfully submit the following as a substitute for the dictum of Mr. Harris: "The practical education is, therefore, an education of the hand to skill and of the brain to intelligence. The combination will give the highest directive power."

5. Better Choice of Occupations.—This point is one of the greatest importance, for out of it are the issues of life. An error here is often fatal. But to choose without knowledge is to draw as in a lottery, and when boys know neither themselves nor the world they are to live in, and when parents do not know their own children, it is more than an even chance that the square plug will get into the round hole.

Parents often complain to me that their sons who have been to school all their lives have no choice of occupation, or that they choose to be accountants or clerks, instead of manufacturers or mechanics.

These complaints are invariably unreasonable; for how can one choose at all, or wisely, when he knows so little!

I confidently believe that the development of the manual elements in school will prevent those serious errors in the choice of a vocation which too often wreck the fondest hopes. It is not assumed that every boy who enters a manual-training school is to be a mechanic; his training leaves him *free*. No pupils were ever more unprejudiced, better prepared to look below the surface, less the victims of a false gentility. Some find that they have no taste for manual arts, and will turn into other paths—law, medicine, or literature. Great facility in the acquisition and use of language is often accompanied by a lack of either mechanical interest or power. When such a bias is discovered the lad should unquestionably be sent to his grammar and dictionary rather than to the laboratory or draughting-room. On the other hand, decided aptitude for handicraft is not unfrequently coupled with a strong aversion to and unfitness for abstract and theoretical investigations. There can be no doubt that, in such cases, more time should be spent in the shop, and less in the lecture and recitation room. Some who develop both natural skill and strong intellectual powers will push on through the polytechnic school into the professional life, as engineers and scientists. Others will find their greatest usefulness, as well as highest happiness, in some branch of mechanical work, into which they will readily step when they leave school. All will gain intellectually by their experience in contact with things. The grand result will be an increasing interest in manufacturing pursuits, more intelligent mechanics, more successful manufacturers, better lawyers, more skillful physicians, and more useful citizens.

In the past comparatively few of the better educated have sought the manual occupations. The one-sided training of the schools has divided active men into two classes—those who have sought to live by the work of their own hands, and those who have sought to live by the work of other men's hands.

Hitherto men who have aimed to cultivate their minds have neglected their hands; and those who have labored with their hands have found no opportunity to specially cultivate their brains. The crying demand to-day is for intellectual combined with manual training. It is this want that the manual-training school aims to supply.

6. Material Success for the Individual and for the Community.—Material success ought not to be the chief object in life, though it may be sought with honor, and worthily won; in fact, success would appear to be inevitable to one who possesses health and good judgment, and who, having chosen his occupation wisely, follows it faithfully. This point might, then, be granted as a corollary to those already given and without further argument; but two points deserve special mention:

I have said that the only article our shops put upon the market is

evenly-trained boys; I now wish to add that the article is a new one. You can not determine its value by invoicing the boys who, in the past, have drifted without proper education and without intelligent choice into shops and offices. I do not claim that manual training will change a dull boy into a bright one, or a bad boy into a good one. It is by no means a sovereign remedy for all the evils that boys are heir to; but it will give the dull boy a chance to become less dull, and the bright one a chance to retain his brilliancy. We have had some bad boys, but I honestly think their badness was less alluring and corrupting and hopeless than it would have been among boys less absorbed in their work. We have had some plain cases of failure, but they had failed everywhere else. It is not safe to reason that, because a boy can not succeed anywhere else, he must succeed in the shop. Brains are as essential to a good mechanic as to a good soldier or a good orator. Undoubtedly, more than half of our boys will find uses for their manual training, and they will have an immense advantage over the untrained boys. They are all fair draughtsmen. They have a wide acquaintance with hand and machine tools, and considerable skill in their use. They have an experimental knowledge of the properties of common materials; of the effects of heat, and the nature of friction. They have analyzed mechanical processes and been taught to adapt means to ends. Such boys will never become mere machine-men. They will never be content to put their brains away like a piece of ornamental toggery for which they have no daily use. If you wish boys to become narrow, unreflecting, bigoted, and helpless, when their machines break down and when they are thrown upon their own resources, don't send them to a manual-training school, for you will surely be disappointed.

Our graduates have been out of school less than a year, but I have seen enough to justify me in saying that their chances of material success are unusually good. As workmen, they will soon step to the front; as employers and manufacturers, they will be self-directing and efficient inspectors. They will be little exposed to the wiles of incompetent workmen.

On the other hand, communities will prosper when their young men prosper. This is the *dynamic age;* the great forces of Nature are being harnessed to do our work, and we are just beginning to learn how to drive. Invention is in its youth, and manual training is the very breath of its nostrils.

7. The Elevation of Manual Occupations from the Realm of Brute, Unintelligent Labor to one requiring and rewarding Cultivation and Skill.—A brute can exert brute strength; to man alone is it given to invent and use tools. Man subdues Nature and develops art through the instrumentality of tools. Says Carlyle: "Nowhere do you find him without tools; without tools he is nothing; with tools he is all." To turn a crank, or to carry a hod, one needs

only muscular power. But to devise and build the light engine, which, under the direction of a single intelligent master-spirit, shall lift the burden of a hundred men, requires a high degree of intelligence and manual skill. So the hewers of wood and the drawers of water are in this age of invention replaced by saw and planing mills, and water-works requiring some of the most elaborate embodiments of thought and skill. Can any one stand beside the modern drawers of water, the mighty engines that day and night draw from the Father of Waters the abundant supply of a hundred thousand St. Louis homes, and not bow before the evidence of "cultured minds and skillful hands," written in unmistakable characters all over the vast machinery?

In like manner every occupation becomes ennobled by the transforming influence of thought and skill. The farmer of old yoked his wife with his cow, and together they dragged the clumsy plow or transported the scanty harvest. Down to fifty years ago the life of a farmer was associated with unceasing, stupefying toil. What will it be when every farmer's boy is properly educated and trained? Farming is rapidly becoming a matter of horse-power, steam-power, and machinery. Who, then, shall follow the farm with honor, pleasure, and success? Evidently only he whose cultivated mind and trained hands make him a master of the tools he must use. With his bench and sharp-edged tools, with his forge and his lathe, he will "direct" and sustain his farm-machinery with unparalleled efficiency.

Some appear to think that the continued invention of tools and new machines will diminish the demand for men skilled in mechanical matters; but they are clearly wrong. True, they will diminish the demand for *unintelligent* labor—and some prominent educators, who take ground against manual training, have apparently no idea of labor except unintelligent labor. If there are more machines, there must be more makers, inventors, and directors. Not one useful invention in ten is made by a man who is not a skilled mechanic. But, as I have said, the mechanics have suffered from a one-sided education. They have paid too little attention to science and the graphic arts. Hence every manual pursuit will become elevated in the intellectual scale when mechanics are broadly, liberally trained.

Undoubtedly the common belief is, that it requires no great amount of brains or intelligence to be a mechanic; and those who go through the schools are not expected by their teachers to be mechanics. Every bright farmer's boy, every gifted son of a mechanic, if he but stay in school, is sure to be stolen away from the occupation of his father and led into the ranks of the "learned professions."

Professor Magnus calls attention to the fact that the promising pupils of the elementary public schools of London, who receive scholarships on account of unusual abilities, are, from a lack of secondary schools suited to improve directly the condition of the artisan classes, always sent on through the classical schools to the Universities of Ox-

ford and Cambridge, and trained to professional or literary careers. Such a result does not react favorably upon the artisan class. The scholarship boys return no more to their homes, and the gulf is widened between the spheres from which they came and those to which they go. Says Magnus, "I very much doubt whether the nation gains much by sending these children into the already overcrowded paths that are open to the university students." This loss of the best minds and the lack of the results of a generous education do much to keep down the estimation in which the working-classes are held, and throw the elements of society out of their proper balance.

Here is where the influence of manual training will be most beneficial. It will bring into the manual occupations a new element, a fairly educated class, which will greatly increase their value, at the same time that it gives them new dignity.

8. THE SOLUTION OF LABOR PROBLEMS.—Finally, I claim that the manual-training school furnishes the solution of the problem of labor *vs.* capital. The new education will give more complete development, versatility, and adaptability to circumstance. No liberally trained workman can be a slave to a method, or depend upon the demand for a particular article or kind of labor. It is only the uneducated, unintelligent mechanic who suffers from the invention of a new tool. The thoroughly trained mechanic enjoys the extraordinary advantage of being able, like the well-taught mathematician, to apply his skill to every problem; with every new tool and new process he rises to new usefulness and worth.

The leaders of mobs are not illiterate, but they are narrow, the victims of a one-sided education, and their followers are the victims of a double one-sidedness. Give them a liberal training, and you emancipate them alike from the tyranny of unworthy leaders and the slavery of a vocation. The sense of hardship and wrong will never come and bloody riots will cease when working-men shall have such intellectual, mechanical, and moral culture that new tools, new processes, and new machines, will only furnish opportunities for more culture, and add new dignity and respect to their calling.

ARE SCIENCE AND ART ANTAGONISTIC?

BY M. M. GUYAU.

A STORY is told of the poet Keats, that once after a dinner at Haydon's, the English painter, he raised his glass and proposed as a toast, "Confusion to the memory of Newton!" When asked his reason for offering this singular sentiment, the poet replied, "Because he destroyed the poetry of the rainbow with his prism."

Is the poetry of things really destroyed by a scientific acquaintance with them? Does all poetry in a sense resemble that many-colored, light-embroidered band which the ancients deified, and whose wholly geometrical and earthly texture Newton laid bare? Pascal said there was no difference between the poet's trade and the embroiderer's; Montesquieu said the poet's business was "to overload reason and nature with fine fancies, as we used to bury women under their dress-trimmings." Voltaire regarded such expressions as only jests, though malicious ones; but they appear to a considerable number of the scientific men and thinkers of the present day to embody the exact expression of a truth. Poetry, which, in the seventeenth and eighteenth centuries, had the majority of the good people on its side, has now, they tell us, only the minority. Science is the great obsession of our age; we all render to it, often unconsciously, a sort of worship, and can not help feeling a kind of scorn for poetry. Mr. Spencer compares Science to the humble Cinderella, who was hidden so long in the chimney-corner, while her proud sisters displayed their tinsels in everybody's eyes. Now Cinderella is taking her turn; "and some day Science, declared the best and the fairest, will reign as sovereign." M. Renan predicts a time "when the great artists will be an antiquated affair, nearly useless, while the value of the scientific man will be more and more appreciated." M. Renan has also expressed regret that he did not himself become a scientific man instead of being a *dilettante* in erudition. Who can say that Goethe, if he had been born in the present age, would not have preferred to devote himself entirely to the natural sciences; or that Voltaire would not have applied himself more to mathematics, in which he showed some force; or that Shakespeare would not have engaged in a more weighty occupation of his psychological powers than the construction of his dramas of human paltriness? Darwin's grandfather devoted a part of his talent to writing poor poems; the grandson, if he had been born a hundred years earlier, might have done the same; but Charles Darwin, in the spirit of the age in which he lived, instead of a poem of gardens, gave us the scientific epic of natural selection. Poems die with their languages, and poets can hope for their works "only an evening of life in the hearts of lovers"; the canvases of painters wear out, and, in a few hundred years, Raphael will be nothing but a name; statues and monuments fall into dust; only thought seems to live, and he who adds a thought to the stores of the human mind may live by its means as long as mankind itself. Must we believe that imagination and feeling are not as vital as thought, and that art must finally give way to science? The question is worthy of consideration, for it concerns the destiny of human genius and the shapes it is to assume in the future.

The writers who predict that poetry and the arts will gradually disappear rest upon a number of facts, some of which are borrowed

from physiology and history, and others from psychology. We will inquire, first, what the natural and historical sciences teach us concerning the medium in which art can live.

Art, to reach its full development, requires around the artist and within him a cultivation of beauty of which the Greeks have given an example. This people had, for purity of form, for the harmonious proportion of the limbs, and for beautiful nudities, a love that went to the verge of adoration; and beauty was, in their eyes, invested with something sacred. This worship of beauty was revived at the renascence. In our days, on the other hand, strength and beauty of body are not the ideal. Many things seem to show that a too exclusive preoccupation with pleasing forms, as well as with ornaments and decorations, are a sign by which we can recognize primitive conditions of civilization. With those modern people who are still in an inferior grade of civilization, as with the Arabs, the male sex itself displays much coquetry, and seeks to please especially with its strength and physical beauty, its vesture, and its adornments. Civilization gradually destroys these primitive instincts, which have been, however, according to Mr. Darwin and Mr. Spencer, the germ of art. The man of our days does not care whether he has, under the convenient and ungraceful vestments that hide him, a well-developed torso and vigorous muscles. Coquetry survives and will doubtless continue to survive with women, but it too often tends to stray from its purpose, which is to bring out the beauty of the members. Women, who ought, more than all other persons, to endeavor to preserve pure and correct forms, take a thousand devices to hinder the development of their bodies and the circulation of their blood. So, not only the ancient culture, but beauty itself, seems to be falling into decadence, and the principal object of the arts is tending to disappear.

Many circumstances in our artificial modern life are combining to produce a tendency to diminution of stature and an augmentation of bodily deformities; among them the constantly increasing division of labor, under which the physical systems of workmen become developed in a single direction only, and too often cramped in other directions; the efforts of philanthropic science to preserve the sick and deformed, and help them propagate their race; the agglomeration of multitudes in cities; conscription, taking the most vigorous men for the army; and the dissipations of society and fashionable life, are producing a kind of reverse selection that may encourage infirmity and ugliness. The brain is becoming more and more the pre-eminently active organ. According to some anthropologists, the nervous system of the civilized man is thirty per cent larger than that of the savage, and it is destined to go on increasing at the expense of the muscular system. It is not probable, however, that this process will go so far as to result in permanent injury, for with the expanding development of the brain will go an increased quickness in detecting whatever evils

may threaten the rest of the system and readiness to apply the remedies. It is one of the prerogatives of science to cure the wounds which itself inflicts, and it will do this in the present case by means of a better regulated education, through a more complete understanding of hygiene and gymnastics, and generally by a more methodical application of the laws that regulate the harmonious development of the organs. While there is doubtless something admirable in the motionless purity of forms, in proportion, and in the perfect adaptation of the organs to their functions which constitute plastic beauty, supreme and really poetic beauty, nevertheless, lies pre-eminently in expression and movement. To the modern age, the face is still the most beautiful part of the man, and that is constantly tending, by the development of the nervous system, of intelligence and morality, to become more expressive. By virtue of the mutual dependence of the organs, the man of future ages, if the development of his nervous system continues in a manner compatible with his general vigor, will wear in his very physiógnomy the steadily brightening reflection of intelligence, "and infinity of thought in the depth of his eyes." Even if the body is less sturdy and less handsome than the bodies of the athletes of Polycletus and the fleshy giants of Rubens, the head will have acquired a superior beauty. Are a brow radiant with living thought and eyes through which the soul is shining of no value from the plastic point of view? Intelligence ultimately impresses its mark upon the whole body, which, if less fitted under its predominance for the combat or the race, gains nevertheless a beauty peculiarly its own. Beauty, in short, will be intellectualized, and the same will be the case with art. Now, if modern art and poetry are to live chiefly by expression; if the head and thought are already assuming an increasing importance in the works of our epoch; if movement, the visible sign of thought, is finally to animate everything with it, as in the works of Michael Angelo and Puget—will art be destroyed in undergoing the transformation? We might say, borrowing the terminology of contemporary science, that the ancients were mainly acquainted with "static" art, while modern art, with its movement and expression, is "dynamic." Following in its course the evolution of human beauty, art tends to rise, as it were, from the limbs to the face and the brain.

History also, as well as physiology, has furnished some specious arguments against the future of art. The development of particular arts seems frequently connected with particular manners and a particular social condition. M. Taine believes that many arts now languishing are threatened with starvation in the future. M. Renan says the reign of sculpture was over when men ceased to go half naked. Epic poetry disappeared when the age of individual heroism passed away, and can not coexist with artillery. Every art, except music, is thus dependent upon a past state; and music, too, which may be regarded as the art of the nineteenth century, will some day have run its course.

The art most compromised in modern times is sculpture. Victor Cousin said, before M. Renan, that there could be no "modern sculpture" with the manners of our days. Admitting that sculpture is declining, the progress of science has had nothing to do with producing this condition. On the other hand, ancient sculpture lived by science. The ancient artists were more learned in the technics of their art than modern artists. In the renascence, Leonardo da Vinci and Michael Angelo were great scientific geniuses. Instead of killing sculpture, it is modern science which will finally be capable of rejuvenating it. Nothing, for example, has been of more value to art than the investigations of such men as Darwin upon the expression of the emotions. Ruskin has written that the sculptor can not be allowed to lack the knowledge or neglect the expression of anatomical detail; but that which is the end to the anatomist is for the sculptor the means. Detail is to him not simply a matter of curiosity or a subject of investigation, but the final element of expression and grace. The change of manners has not produced and will not produce the disappearance of statuary. We may not have another Venus of Milo or Hermes of Praxiteles. But no one can assert that the sculptor may not become capable of embodying in stone ideas and poetic emotions which the Greeks, with all the plastic perfection they attained, could not translate or even conceive. Praxiteles could not have imagined Michael Angelo's "Night" or "Aurora," any more than Michael Angelo could have executed some of the works of Praxiteles.

Painting enjoys a still greater promise of vitality and advancement. Color is eternal. No Newton, with his explanations of the aërial arch of the rainbow, will be able to break it up or to do away with it. The sense of color has even grown since antiquity. The Greeks were without words to describe a considerable number of colors which we distinguish; and their artists had certainly not as fine perceptions of color as Titian or Delacroix. Mankind seems to have been all the time growing more sensible to the language of tints, and to all the plays of light. Here, certainly, is an open road for art.

The language of sounds is likewise inexhaustible. The idea of melody responds to a particular mental and moral condition of man which changes from age to age; it will, therefore, change and make new advances with man himself. A class of musicians like Chopin, Schumann, and Berlioz have expressed feelings congenial to our epoch, and corresponding with a condition of the nervous system which Handel, Bach, and Haydn could hardly have understood. Mr. Spencer has shown that music is a development of accent made by the voice under the influence of passion. The variations of tone, the modulations natural to the human voice, grow refined as the nervous organization becomes more delicate. Musical melody following the variations of human accents is capable of taking on as many shades as

there are feelings in the heart. Rossini has already been criticised with severity for the innovations he introduced into musical composition, and for his departure from the simple themes and solos of the olden time. A similar reproach was laid against Wagner, and is doubtless held in reserve for the next musical genius that shall arise.

Extinction has also been predicted for the poetic art, but with no better reason than for the other arts. Great poets still exist, and are still produced. They may not excel in the same way as their predecessors, but they excel as well, and reflect with equal power and equal grace the feelings of their age.

From the external conditions of art we pass to the mental and moral conditions; they are the most important ones. The question before us is, if the scientific spirit, which is gradually penetrating humanity and fashioning its brain from generation to generation, will not, in the long run, destroy the three essential faculties of the artist —imagination, the creative instinct, and sentiment.

According to some philosophers, the development of the scientific spirit is destined to arrest that of the poetic imagination. The reign of science, succeeding to the dynasty of legends and religions, will engender a reign of "platitude"; without mystery, say others—without superstition, Goethe added, there can be no true poetry. The poetic imagination does, in fact, need a kind of superstition, in the ancient sense of the word, which will not permit it always to explain events by their cold reasons, and a sort of ignorance, a demi-obscurity, under the cover of which it may play at will around things. Nothing is less poetic, we might say, than a broad, bare road devoid of nooks and turnings, with the sun shining directly upon it; but thickets, shrubberies, shady corners, or anything we can not look into at the first glance, whatever appears to hide from and evade us, these constitute rural poetry. The fault of bare plains is that they conceal nothing from us, and we do not like a straight line because we can see all there is to the end of it. The indefinable charm of evening consists in its showing us everything half veiled; and of moonlight that it gives a softness to objects whose outlines we can only dimly make out, and causes them to appear as through a thin, transparent obscurity. If the skies were cleared of what about them is mysterious, what would distinguish them from the earth we tread under our feet? The "aching for the infinite" that troubles some minds, also gives them some of their most precious joys; and such minds would probably be reluctant to exchange it for universal knowledge.

To us the incompatibility which these writers endeavor to establish between poetry and science is superficial. Poetry will always find a justification in science. Matthew Arnold remarks, in his essay on Maurice de Guérin, that poetry as well as science is an interpretation of the world. The interpretations of science will never give us that intimate sense of things that the interpretations of poetry give

us, for they address themselves to a limited faculty, not to the whole man; for that reason poetry is eternal. All the theorems of astronomy will never prevent the view of the infinite sky exciting the vague restlessness in us and the unsatisfied desire to know which constitute the poetry of the heavens. Are there any discoveries that do not touch upon other mysteries, and thus favor the always still wider play of the imagination? Science, which begins by astonishment, ends also, Coleridge says, with astonishment, of which poetry as well as philosophy is born; there is, therefore, an eternal suggestion, and consequently an eternal poetry in science. That very craving for the mysterious and the unknown which the human imagination feels, will appear, if we analyze it to the end, a disguised form of the desire to know. We have just spoken of the peculiar charm of narrow roads, of thickets, and turnings; the chief source of their charm is in their allowing us to make discoveries at every step, in their keeping the mind in a constant stretch of curiosity. The poetry in them does not come only from their closing the horizon to us, but rather from their always promising us something new. That science is constantly changing the points of view from which we have been in the habit of regarding men and things, that it keeps on producing new light-effects, and often surprises, and even vexes us, no one will deny; but what is there in that to disturb the poet? I have sometimes envied the ant, whose horizon is so narrow that it has to mount a leaf or a stone to see a half step around itself; it must be able to distinguish a host of things that wholly escape us; to it a gravel-walk, a piece of turf, the bark of a tree, are replete with poetries unknown to us. If its view were enlarged it would be at first unhomed, and in the sight of our forests and mountains would miss the fleeting shadows of its grass-blades. So if we were to rise high enough we should regret to see the poetry of details disappearing, the little things blending together, all the angles in which our thought was lost smoothed away, all the turns that excited our curiosity straightened out. Nothing, at first sight, but the view of a grand whole, bare and shadeless, in a harsh, uniform light; but what breadth! As we survey it, we see still beyond it, a new set of endless perspectives still losing themselves in the shadows; still something to look at, to learn, and to experiment upon.

There is another mystery which science can not destroy, and which is destined to be always a theme of poetry; the metaphysical mystery. There is no need of weaving, as the theologians do, new obscurities around the one that everlastingly envelops the beginning of things; having got to that, the investigator himself, obliged to stop, may suffer himself, as Claude Bernard says, "to be rocked in the wind of the unknown, amid the sublimities of ignorance." Science may dispel, without poetry suffering by it, the artificial mysteries of religions, which apply their symbols even to the explanation of purely scientific phe-

nomena; but it can never destroy this metaphysical mystery, which bears not only upon unknown laws, but upon the essence of things which are perhaps really incognoscible. That mystery will always be competent to sustain in art, above that of the beautiful, pure, and simple, the emotion of the sublime.

Superstition does not appear to us any more indispensable than mystery or ignorance to the flight of the imagination, although Goethe has described it as "the poetry of life." In their origin, it is true, the religious myths had their poetry; but it was, after all, because they were first attempts at explanation. Superstition consists essentially in putting in things, or back of them, wills like ours. Animals are not superstitious, because they do not try to comprehend. Man, on the contrary, tries to account for the phenomena he perceives, and, in order to do this, projects himself, in a fashion, into them. This first attempt to systematize the universe had a kind of grandeur, even in a scientific view, and had also its poetry. But the myths of the ancient ages can no longer be seriously regarded in the age of science. Is this to be regretted for the sake of art? Yes, they say; for it was more poetical to put wills like ours behind exterior objects than to submit them to the hard laws of science: a law is not as good as a god. But we answer to this, that a law in itself has something of the divine. As one of the characteristics of divinity is infinity, a law connecting phenomena one with another, and inviting us unhaltingly to ascend the chain of causes, opens immense perspectives to the mind, and gives to whoever investigates it a view of infinity in the smallest objects, or, we might say, makes the infinite present in every phenomenon. While mythology compels the mind to stop in its search for causes, giving the capricious will of some god as its final explanation, science removes all limitations and puts the mind in immediate view of infinity. From this arises a new kind of poetry, more austere, perhaps, but more profound and more lasting. When Leibnitz respectfully put back upon a leaf the insect he had taken from it to look at through the microscope, he did not regard it with the same eye as an ancient would have regarded it. In that atom he perceived, as Pascal did in the flesh-worm, an epitome of the world. This idea of the infinite divine is quite as precious as are the classic wonders and the tinsel decorations of Olympus. The poet loses nothing in the transformation of the universe by science. Mr. Spencer, who once defended the poetry of science against that of the Greek odes, has made some just remarks on this subject. To the man of antiquity or to the ignoramus of our own days, a drop of water is only a drop of water. How it is changed in the eyes of the scientific man when he thinks that, if the force that holds its elements together were set free, it would produce lightning! A dish of snow becomes a wonder when one examines with the microscope the varied and elegant forms of its crystals. A rounded stone striated with parallel scratches calls up the thought of the glacier

silently sliding over it millions of years ago. Art and science have this in common, that both require genius as a condition of their full development. Science in its highest departments, like art, can not live and grow except by incessant discovery. The faculty which enabled Newton to divine the law of the stars is the same with that by which Shakespeare perceived the psychological laws that govern the characters of *Hamlet* and *Othello*. Like the poet, the man of science also must always be able to put himself in thought in the place of Nature, to learn how she acts, and to represent to himself what she might do if one should change the conditions of her action. The art of either is to place the beings of Nature in new circumstances, as if they were active personages, and thus, to as great an extent as possible, to renovate or new-create Nature. The hypothesis is a kind of sublime romance, a scientific poem. Kepler, Pascal, and Newton had, as Mr. Tyndall remarks, the temperaments of poets, almost of visionaries. Faraday compared his intuitions of scientific truth to "interior illuminations," to a sort of ecstasies that raised him above himself. Once, after long reflections on force and matter, he perceived in a poetic vision the whole world "traversed by lines of forces," the endless vibrations of which produced light and heat throughout immensity. This instinctive vision was the origin of his theory of the identity of force and matter. Science, then, in the face of the unknown, comports itself in many respects as poetry does, and demands the same creative instinct. For its advancement is required the power of intuitive intelligence collected by many generations; insight, as Carlyle calls it, to perceive the true or the beautiful before having a full knowledge of it.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

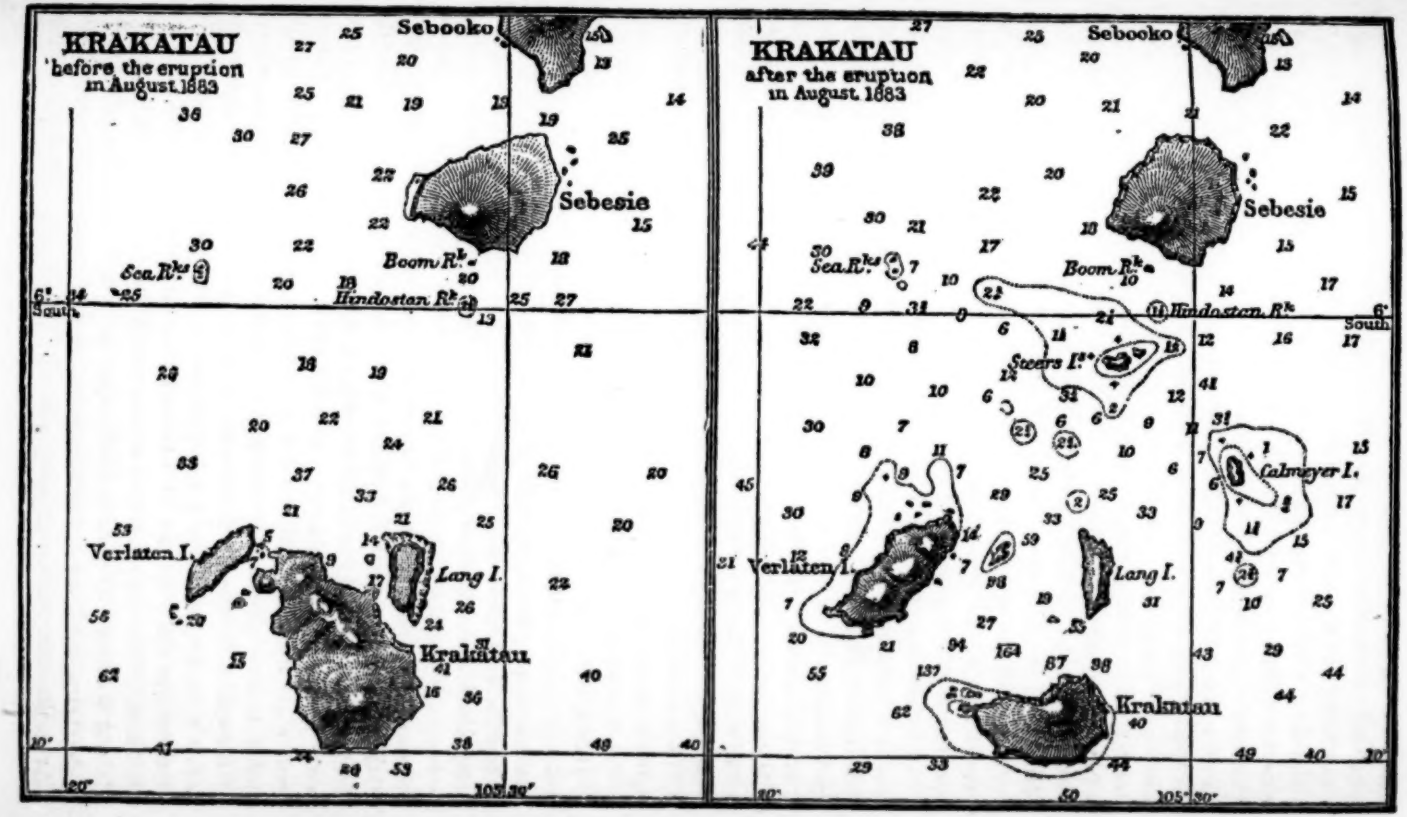
THE VOLCANIC ERUPTION OF KRAKATAU.

CONSIDERING that the volcanic eruption, of which the Straits of Sunda have been for the last eight months the center, is among the most stupendous of our times, and that the attendant phenomena have given rise to many questions of the highest scientific and, we may add, geographical interest, a *résumé* of the facts compiled from all the latest available sources may be interesting to our readers.

The Island of Krakatau (such, and not Krakatoa, is the native name) is situated in latitude 6° 7′ south, longitude 105° 26′ east, in the fairway of the Sunda Straits, about equally distant from Java and Sumatra, close on twenty-six miles west-southwest from the village and lighthouse of Anjer, the call-port or signal-station, prior to the present eruption, for all vessels passing through that frequented channel. It was a small, uninhabited island about five miles in length and three in

breadth, culminating in two elevations, the taller of which, known as the Peak of Krakatau, rises (or did rise) some 2,750 feet above the sea. Surrounding it on all sides are numerous volcanic cones. The Tengamoes (or Kaiser's Peak) to its northwest is situated at the head of the Semangka Bay, and the quiescent Rajabasa to its northeast in the southern promontory of Sumatra; in the east by south the Karang smolders in Bantam, and southeast rise the active cones of the Buitenzorg Mountains. Standing in the straits and very little to the north of Krakatau are the two dormant or dead cones of Sebesie and Sebooko. A line drawn from Rajabasa, passing along the western side of Krakatau, and continued thence to Prince's Island, which lies off Java Head, would mark the boundary on the eastward side of the shallow Java Sea, which rarely exceeds fifty fathoms, and on the west side of the deep Indian Ocean. On looking at the accompanying map of the locality before the eruption it will be seen that close to the east and northwest sides of Krakatau there are two small fragments of land, Lang and Verlatin Islands respectively. It is Mr. Norman Lockyer's opinion that these are two higher edges of the old rim of a subsided crater, overflowed in part by the sea through inequalities in the margin between them; that the heights on Krakatau itself, the remaining portion of the old volcano summit, are cones elevated on this old crater-floor; and that the ancient funnel is practically coextensive with the area inclosed by these three islets, though till the 20th of May last blocked up by volcanic *débris*.

The earliest accounts of Krakatau we have been able to obtain are contained in a curious old volume, "Aenmerckelijke Reysen van Elias Hesse nae en in Oost-Indien van't jaar 1680 tot 1684" ("Remarkable Journeys of Elias Hesse to the East Indies from the Year 1680 to 1684"), published in Utrecht in 1694. The author relates that he passed on the 19th of November, 1681, "the Island of Cracatouw, which is uninhabited. It had about a year before broken out in eruption. It can be seen far at sea, when one is still many miles distant from it, on account of the continually ascending smoke of the fire; we were with our ship very close under the shore; we could perfectly well and accurately see the wholly burned trees on the top of the mountain, but not the fire itself." About the same period Johann Wilhelm Vogel, one of the Dutch East India Company's servants, who published in 1716 a very interesting account of his travels there, passed through the straits. He says: "On February 1, 1681, by God's help, in front of the Straits of Sunda, where, with great astonishment, I saw that the island of Cracketouw, which on my former journey to Sumatra appeared so very green and gay with trees, lay now altogether burned up and waste before our eyes, and spued out fire from great fire-holes. And on inquiry at the ship, Captain . . ., at what time it broke out, . . . I was told that it was in May, 1680. . . . The former year, and when he was on his voyage from Bengal, he had met with a


KRAKATAU
before the eruption
in August 1883
Sebooko
Sebesie
Sea Rks
Boom Rk
Hindostan Rk
Verlaten I.
Lang I.
Krakatau
KRAKATAU
after the eruption
in August 1883
Sebooko
Sebesie
Sea Rks
Boom Rk
Hindostan Rk
Steers I.
Calmeyer I.
Verlaten I.
Lang I.
Krakatau

great storm, and about ten miles from this island he encountered an earthquake on the sea, followed by most frightful thunders and cracklings, from which he imagined that an island, or else a piece of the land, had burst up, and shortly thereafter, as they drew a little closer with the ship to the land, and were come near to the mouth of the Sunda Straits, it was evident that the Island of Cracketouw had burst out; and his conjecture was correct, for he and all the ship's company perceived the strong sulphur-atmosphere, also the sea covered with pumice, . . . which they scooped up as curiosities." Save for the observations of passing travelers, by whom the great beauty of its tree-clad slopes, the first verdant spot to meet the eye after weary weeks at sea, has been gratefully described, the volcano, after it died out, has had an uneventful and unrecorded history.

On the 20th of May last year, at half-past ten in the forenoon, the inhabitants of Batavia were astounded by hearing a dull, booming noise, whether proceeding from the air or from below was doubtful, soon followed by the forcible drumming and rattling of all the doors and windows in the place. The commotion was strongest between half-past ten and one o'clock in the day, and between seven and eight in the evening. About midday a curious circumstance was observed—that in some spots in the city no vibrations were perceived, although the surrounding buildings were experiencing them. It was at once concluded that a volcanic eruption of an alarming character had taken place, but for some time it was impossible to localize the direction of the sounds, though the west was the quarter of the compass to which most people assigned them.

A report, issued next day by the director of the observatory in Batavia, stated that, as he had no instruments for recording the intensity and direction of earthquake-shocks, he could certify only that no increase of earth magnetism accompanied the tremblings—the photographs indicating nothing abnormal; and that the quivering was absolutely vertical throughout the periods mentioned above; for a suspended magnet with an exact registering apparatus gave no indications of the slightest horizontal oscillations, but alone of vertical vibrations. This was verified by the observations of one of the philosophical-instrument makers in the town on a pendulum in his shop, where only vertical trillings were observable at a time when the windows and glass doors of the house were rattling, just as if shaken by the hand, in so violent a way that it was difficult to carry on conversation. Nowhere, however, do there seem to have been observed any shocks of a true or undulatory earthquake. From midnight of the 20th throughout the forenoon of the 21st the tremulations continued very distinct. The same morning a thin sprinkling of ashes fell, "whence, is not known," both at Telok-betong and at Semangka, situated in Sumatra at the head of the Lampong and Semangka Bays respectively. At Buitenzorg, thirty miles south of Batavia, the same phenomena

were observed; while in the mountains farther to the southwest they were even more pronounced, and the Karang, a mountain situated about west from Batavia, it was thought must be the seat of disturbance. By this time the general opinion had decidedly ascribed to the west or northwest the direction whence the movements were proceeding. Krakatau itself was even named; but some of the Sumatran mountains were considered more likely to be the delinquents. Batavia being connected with that island by a telegraph line passing along the north coast of Java to Anjer, across the Straits of Sunda to Telokbetong, thence northward to Palembang on the east, and to Padang on the west coast, intelligence from all parts soon began to come in; but none of any eruption anywhere, beyond the notice of the fall of ashes mentioned above. Anjer telegraphed, "Nothing of the nature of an earthquake known or felt here." This was dated the 21st; a message in much the same terms had been received on the previous day, as well as the report of one of the Government officials to the following effect: "On Sunday morning, the 20th, I landed at Anjer, and there staid till one o'clock in the afternoon; at half-past three I reached Serang, and halted an hour. Neither I nor my coachman, either at Anjer or at Serang, or on my whole journey to Tangerang (near Batavia), felt or heard any earthquake or disturbance, or anything at all remarkable."

Anjer lies on the narrowest part of the Sunda Strait, twenty-seven miles from Krakatau, which formed a prominent object in one's seaward view from the veranda of its quiet little hotel on the sea-margin. This hotel was kept by one of Lloyd's agents, Mr. Schuit (whose family perished in the subsequent disaster), who had in his veranda a powerful telescope for reading the signals of ships for report to Batavia, and by whom consequently any occurrence in the strait could scarcely fail to be observed. Thus during the period of greatest disturbance in Batavia and Buitenzorg, when men there were referring the origin to Krakatau, eighty miles away, at Anjer, only twenty-seven miles distant from it, nothing was felt or heard. The same report was made from Merak, likewise situated on the straits, thirty-five miles from and presenting a clear outlook to the volcano. The winds prevalent in this region during the month of May are from the east, and would tend to drive any smoke and ashes toward the Indian Ocean, which might explain their not being detected from Anjer; but the direction of the wind fails to account for the entire absence in that and the surrounding villages of the phenomena which were most conspicuous in Batavia.

Not till the evening of the 21st was smoke observed to be issuing from Krakatau; on the 22d the volcanic vent there seems to have been fully established, and the vibrations and other phenomena experienced in Batavia quickly subsided. Now, in a letter to "Nature," Mr. H. O. Forbes has recorded the passage, during the 11th and 12th

of July, of the ship (on board which he was returning to England) through extensive fields of pumice spread over the ocean north and south as far as the eye could reach. The vessel passed the volcano on the 9th, but till the evening of the 10th, when the steamer would be about a degree to the west (a little northerly) of her noon position, which was 102° 25′ east longitude, 6° 20′ south latitude, no pumice was observed. During the whole of the 11th the vessel was surrounded by the pumice-sheet, which about noon of the 12th, in 93° 54′ east longitude, 5° 53′ south latitude, suddenly terminated, shortly after it had appeared in greatest amount, while a current had been encountered after leaving the entrance to the straits, running against the ship's course at the rate of a quarter of a mile an hour. The pumice-nodules were considerably worn, but many pieces were observed as large as a child's head. Several lumps were picked up infested with barnacles, of from one to one and a half inch in length, which represented at least some four or five weeks' growth.

The specimens of pumice obtained at sea have been submitted to Professor Judd and the committee appointed by the Royal Society for the examination of the phenomena connected with the eruption. If, on analysis, they should prove different in composition from specimens obtained directly from the volcano, a different origin will have been established for them; but, should both turn out to have identically the same components, it will not necessarily prove that both have come from the same crater. The Peninsular and Oriental Company's steamer Siam, on her voyage from King George's Sound to Colombo, sailed for four hours, on August 1st, through a similar "lava" (pumice) sheet, in latitude 6° south, and 89° east longitude, the nearest land, the coast of Sumatra, being seven hundred miles off, and the current then running eastward at from fifteen to thirty miles a day. The soundings at the spot reached two thousand fathoms. Mr. Forbes, who incidentally referred to the eruption when reading his paper before the society on the 28th of January last, suggested that the sounds heard in Batavia on the 20th of May, which were altogether unperceived at spots so near Krakatau as Anjer, Merak, and Telok-betong, which would be inexplicable if they really originated there, were the result of a submarine eruption in the Indian Ocean, somewhere southwesterly from Java Head; and that the tremors were propagated thither perhaps by continuous strata connecting the *locale* of the outburst with Batavia, Buitenzorg, and more especially with the hills to the southwest, where the manifestations were so distinctly perceived. We know from Mr. Darwin's * and Mr. Forbes's † observations, that the center of volcanic disturbance does exist in that direction, in the Keeling Atoll, situated six hundred miles west by south from the mouth of the straits. Whether or not anything unusual has been experienced in these

* "Narrative of Survey Voyages of the Adventure and Beagle," vol. iii.

† "Proceedings of the Royal Geographical Society," December, 1879.

islands about the third week of May, no intelligence has yet reached this country. We know, from what occurred at Graham's Island, that pumice ejected from the sea-bottom rises to the surface, and an examination of the chart of the currents in the Indian Ocean at once shows that any flotsam in the region between west and south of Java Head in that longitude could be drifted to the locality in which it was observed in the month of July. If such a submarine outburst did take place, Mr. Forbes suggested that somehow the orifice very soon became blocked after a great in-rush of water had taken place, which, becoming transformed into steam under enormous pressure, shaped its course for the nearest old earth-scar, and found vent in Krakatau, by an offshoot probably of the funnel of the eruption of 1680. That such large lumps of pumice should be carried seven hundred miles westward into the Indian Ocean does not seem probable, and is not supported by any observations. The earlier outbursts were not of very unwonted vigor, for no pieces of any size are reported to have fallen on the neighboring coasts of Java and Sumatra; even after those of August, no ship farther off than one hundred miles speaks of the fall of any but the "finest dust and sand."

On the 23d of May, a ship encountered at Flat Cape, in Sumatra, a large amount of pumice on the sea, which increased in amount as Krakatau was neared. Of the appearance of the volcano on the 27th, we have a graphic account in the "Algemeen Dagblad" newspaper, of Batavia, by one of a party that ascended to the crater on that day. As they approached the scene, the neighboring islands had the appearance of being covered with snow. The crater was seen to be situated not on the peak, but in a hollow of the ground, which lay from southeast to northwest, sloping toward the north point, in front and to the north side of the lower summit, looking toward Verlaten Island. Both heights were seen; the southerly green, and the more northerly and much lower one quite covered with dust and ashes. The volcano was ejecting, with a great noise, masses of pumice, molten stone, and volumes of steam and smoke, part of which was being carried away westward by the monsoon wind, dropping all round and close at hand its larger pieces, while a higher rising cloud is specially recorded as driving away eastward, having evidently encountered a current in that direction in the upper air. Some of this dust-cloud was carried far to the eastward, for Mr. Forbes relates that on the morning of the 24th of May, when in the Island of Timor, twelve hundred miles distant, he observed on the veranda of his hut, situated high in the hills behind Dilly, a sprinkling of small particles of a grayish cinder, to which his attention was more particularly drawn later on that and the next day by their repeated falling with a sudden pat on the page before him. The visitors to the crater seemed to have viewed with most amazement the grandeur of the smoke-column whirling upward with a terrific roar like a gigantic whirlwind, through whose sides the

ascending *ejecta*, vainly trying to break, were constantly sucked back and borne upward round and round in the center of its Stygian coils. The trees which once clothed this portion of the island presented only bare stems from which their crowns had disappeared, evidently not by fire, for there was no charring visible on them, but rather as if wrenched off by a whirlwind—perhaps of the crater itself.

After the 28th, curiosity in these volcanic phenomena seems to have abated, and during the next eight or nine weeks, though the eruption continued with great vigor, little is recorded of its progress; indeed, so completely did it seem to have been forgotten, that visitors to Batavia, unless they had made inquiries, might have failed to hear of its existence at all. During this period no local disturbances to attract attention or to cause the least alarm are recorded. From the logs of ships in the neighborhood of the straits, about the middle of August, numerous extracts have been published; but many of them show that they have been written either with the mind bewildered and confused by the terrifying incidents amid which the officers found themselves, or from the after-recollection of the events, of which under such conditions the important dry facts of time, place, and succession, are liable to be unconsciously misstated. Much is therefore lost which might have been known; but a few are of the utmost value.

On the 21st of August the volcano appears to have been in increased activity; for the ship Bay of Naples reports being unable to venture into the straits on account of the great fall of pumice and ashes.

The first, however, of the more disastrous effects were experienced on the evening of the 26th, commencing about four o'clock in the afternoon. They were inaugurated by violent explosions heard in Anjer, Telok-betong, and as far as Batavia, accompanied by high waves, which after first retreating rolled upon both sides of the straits, causing much damage to the villages there, and were followed by a night of unusually pitchy darkness. These horrors continued all night with increasing violence, till midnight, when they were augmented by electrical phenomena on a terrifying scale, which enveloped not only the ships in the vicinity but embraced those at a distance of even ten to a dozen miles. As the lurid gleams that played on the gigantic column of smoke and ashes were seen in Batavia, eighty miles off in a straight line, we can form some idea of the great height to which the *débris*, some of which fell as fine ashes in Cheribon, five hundred miles to the east, was being ejected during the night.

Between five and seven o'clock (for the hour is uncertain) in the morning of the 27th, there was a still more gigantic explosion, heard in the Andaman Islands and in India, which produced along both shores of the strait an immense tidal movement, first of recession and then of unwonted rise, occasioning that calamitous loss of life of which we have all heard.

The material thrown out rose to an elevation which we have no means of estimating, but so tremendous was it that on spreading itself out it covered the whole western end of Java and the south of Sumatra for hundreds of square miles with a pall of impenetrable darkness. During this period abnormal atmospheric and magnetic displays were observed ; compass-needles rotated violently, and the barometer rose and fell many tenths of an inch in a minute. Following at no great interval, and somewhere between ten and twelve o'clock in the forenoon of the same day, either by successive rapid outbursts or by one single supreme convulsion, the subterranean powers burst their prison-walls with a detonation so terrific as to have been, as it seems, inaudible from its very immensity to human ears in its close vicinity, but which spread consternation and alarm among the dwellers within a circle whose diameter lay across nearly three thousand miles, or fifty degrees of longitude.

With sunrise on the 28th the dense curtain which had enveloped so wide an area in darkness gradually began to clear off, and the light broke on a scene of devastation of the saddest kind, but on one of comparative placidity, as if Nature lay exhausted after her frantic paroxysm. Krakatau was seen reduced to a fraction of its original size ; the whole of the northern portion, with the height in front of which the volcano first broke out, and half of the peak itself, had vanished (see the accompanying map). To the northward, however, two new pieces of land, which have received the names of Steers and Calmeyer Islands, raised their tops above the surface of the sea, where the morning previous thirty to forty fathoms of water had existed. Of the two islets on each side of Krakatau, Lang Island is left practically unaltered, while Verlaten Island seems elevated somewhat, and is reported to be in eruption. But, where the volcano had been so active a few hours before, a sea fathomless with a line of a thousand feet is now to be found.

Having thus followed the succession of events, there remains little doubt that the crater on the 26th of August by its constant action had either cleared out the old funnel into its submerged portion, or that a rent by subsidence or otherwise was formed, through which a volume of water was admitted to the heated interior, resulting in explosion after explosion in increasing violence, as more material for generating steam was finding its way into the underground recesses.

The first great waves on the evening of the 26th and the early part of the 27th were probably caused by a portion of Krakatau being shot out northward for eight miles and dropped where we have now Steers Island ; while the appalling detonation in that forenoon and the greater wave accompanying it resulted perhaps from that still more Titanic effort which lifted the greater portion of Krakatau—several thousand million cubic yards of material—out by its one hundred and seventy fathom root, hurled it through the air over Lang

Island, and plunged it into the sea some seven miles to the northeast, where Calmeyer Island now blocks the channel which mariners have known so long as the East Passage.

The reports we have as to the tidal phenomena differ from different places. At many points it was observed that a distinct withdrawal of the water preceded the rise or great tide; while from others, as in the canal at Batavia, the opposite is given as the order of occurrence. Everything, however, depends on the moment of the observation. It will be apparent that these waves were the most natural consequents of the events, and were due certainly not to any seismic movement of the sea-bed, but, on the one hand, to the in-rush of water to fill the deep chasms out of which the ejected portions of the island came, which was naturally followed first by a withdrawal of the water, and then by a disastrous recoil over the low fore-shores of Java and Sumatra; and on the other hand to the tremendous stroke —the splash, in fact—imparted to the sea by such a gigantic block of matter, square miles in size, which must have resulted first in a great rise of water, followed by a withdrawal.

It is a remarkable circumstance that in the logs of several ships which were in the close vicinity of the volcano in the forenoon of the 27th, no mention is made of the great wave which proved so destructive, and which could scarcely, one conceives, have failed to attract attention. May the explanation not lie in the supposition that these two great waves—the in-rush and the splash waves—which would follow each other after a short interval, had neutralized each other at the spots where these vessels chanced to be at the moment? Issuing from the narrow straits into the oceans east and west, these waves started off on their journey round the globe, and, from the records of the tide-gauges which are now coming in, we have a most remarkable tale unfolded. On the afternoon of the same day that the greater of them swept away the Javan villages, the undulations were registered unmistakably in Mauritius, the Seychelles, in South Africa, and on the shores of the Pacific islands; but, as Mr. Lockyer informs us, they did not vanish there, but proceeded onward, and, crossing each other on the antipodes of Krakatau, journeyed back to the spot whence they had emanated, and this they did no fewer than four times before the equilibrium of the sea was restored so far as to be insensible to our instruments. While the tide-gauges have recorded their story, the delicate fingers of the barometrical registers of the world have also borne uninfluenced testimony of a similar kind. The blow which hurled such a mass of matter into the air, which originated a hurricane there and caused the barometers in the neighborhood of the volcano to rise and fall with unparalleled rapidity and a vessel distant three hundred miles to tremble, started an atmospheric wave also round the globe. It was first detected in the Kew registers, we believe, by General Strachey, who has now ex-

amined a large number of barographs, from which he has been able to fix the dates at which the atmospheric undulations passed various places on the earth's surface. As in the sea, so in the air, two waves, one to the east and one to the west, started from Krakatau, whose rate of progress has been found to be that of sound. One surprising circumstance, of which we have as yet observed no explanation, is how those ships which were near the volcano at the moment of the supreme explosions, of the enormity of which they seem not to have been cognizant, notwithstanding that they were heard at such immense distances, did not only not suffer from the concussion, but were not blown off the face of the water altogether. Almost coincident with the record of the abnormal atmospheric fluctuations, magnificent sunlight effects, unusually lurid skies, prolonged dawns, lengthened twilights, and green or blue or moon-like suns, began to be observed. From the dates at which these phenomena first appeared in different parts of the world—on the east coast of Africa on the second day, the Gold Coast on the third, Trinidad on the sixth day, at four thousand miles in the Pacific west of Panama on the seventh, and at Honolulu on the ninth day—it can be seen that the volcanic cloud followed a straight path.

To what height the supreme outburst propelled the smoke, dust, and the lighter portion of matter, it is impossible at present to estimate. Mr. Whymper saw Cotopaxi, in by no means one of its extraordinary expirations, eject a column over 20,000 feet in height; but many multiples of this distance will doubtless be required to measure the spire that was shot sky-ward on the forenoon of the 27th of August last. At all events it rose so high that months have been required for it to descend. Those places situated below the direct westward path of the cloud, which would be elevated at first as a narrow column, as they were carried under it by the eastward rotation of the earth, were the first to have the usual light of the sun changed into ominous displays or delightful after-glows, varying in intensity according to their time-distance away, and therefore to the amount of the obstructing dust, which would also condense moisture in the upper part of the air, and give special absorption effects,* that had by the hour they were reached subsided from the atmosphere. This narrow band, gradually spreading out north and south, enabled the inhabitants of all lands to obtain a view of the gorgeous effects of broken and absorbed sunbeams, and a demonstration of the vastness of the power of imprisoned steam.

Many questions connected with the subject remain at present unexplained; but the difficulties will in great part doubtless disappear before our fuller information. A committee of the Royal Society, consisting of our highest authorities in meteorological, volcanic, and light phenomena, has, as we have said, been appointed to fully investi-

* Cf. "Nature," February 21, 1884, pp. 381, 382.

gate the subject, and from their labors we shall by-and-by be in possession of the first really accurate and scientific examination of the effects of volcanic eruptions, which in this case bids likely to result, to meteorological science at least, in a gain whose immense importance it is impossible now to calculate. Nor is it unlikely that this "biggest terrestrial experiment" afforded us by Nature may ultimately prove to have been not the least of her beneficent gifts to humanity.—*Proceedings of the Royal Geographical Society.*

THE PREVENTION OF HYDROPHOBIA.*

By M. LOUIS PASTEUR.

THE important fact that certain viruses may be varied in potency, and that protection against one may be afforded by another less potent, is to-day not only gained for science, but has entered the stage of application. It is obvious that great interest attaches, in pursuing this line of study, to the investigation of methods of attenuation adapted to new virus. I announce to-day an advance thus made in regard to rabies.

In passing from a dog to a monkey, and then from one monkey to another, the potency of rabies-virus decreases at each transfer. After its strength has been thus diminished, if the virus is then transferred to a dog, a rabbit, or a Guinea-pig, it still remains attenuated. In other words, it does not regain all at once the intensity of virus from a mad dog. Only a small number of transfers from monkey to monkey is necessary to bring the virus to such a state of attenuation that it will not induce madness in a dog when introduced hypodermically. Even inoculation by trepanning, that most certain method of communicating rabies, will produce no result except that of causing in the animal a condition of insusceptibility to rabies.

The potency of rabies-virus increases in passing from one rabbit to another, or from one Guinea-pig to another. When it has been brought to a maximum in rabbits, it exhibits its full strength on being transferred to the dog, and is then more potent than virus from a mad dog. Such virus inoculated into the circulatory system of a dog invariably causes madness which results in death.

Although the virus rises in potency at each transfer from rabbit to rabbit, or from Guinea-pig to Guinea-pig, it must pass through several of these animals in order to regain its maximum potency, when this has first been reduced in monkeys. In like manner, the virus of

* Communicated to the Academy of Sciences, May 19, 1884, by M. Pasteur and MM. Chamberland and Roux.

a mad dog, which, as I have just stated, lacks much of being of maximum potency, when transferred to the rabbit, must pass through the systems of several individuals before reaching its maximum.

A rational application of the results which I have just made known leads readily to the rendering of dogs insusceptible to rabies. We have learned that the experimenter may have at his disposal attenuated rabies-viruses of different strengths; some which are not fatal will protect the system from the effects of more active viruses, and the latter against those which are fatal. Let us take an example. Rabies-virus is obtained from a rabbit which has died from trepanning after a period of incubation which exceeds by several days the shortest time in which the disease may be induced in the rabbit. This invariably takes place within seven or eight days after inoculation by trepanning with the most potent virus. The virus from the rabbit in which the incubation has been long, is inoculated, by trepanning, into a second rabbit, and the virus from this one into a third. With each successive transfer, some of the virus, which becomes stronger and stronger each time, is inoculated into a dog, who becomes gradually more hardened against the operation of the poison, until he is finally found capable of withstanding a fatal virus. He then becomes entirely insusceptible to rabies, the virus of a mad dog producing no effect upon him, whether introduced by intra-venous inoculation or by trepanning. By inoculation of the blood of rabid animals, under certain conditions, I have succeeded in greatly simplifying the operations of vaccination, and in producing in the dog the most decided state of insusceptibility. I shall soon make known the details of the experiments on this point.

Until the time when rabies shall have become extinct through vaccination, the prevention of the development of this affection, in consequence of bites by rabid dogs, will be a problem of considerable interest. In this direction, the first attempts which I have made give me the greatest hopes of success. The period of incubation after biting is, I have every reason to believe, of such length that the subject may be rendered insusceptible before the fatal form of the disease develops. The preliminary experiments are very favorable to this opinion, but the tests must be infinitely multiplied on various species of animals before therapeutics will have the boldness to try this preventive on man.

Notwithstanding the confidence with which the numerous experiments I have made during the last four years inspire me, I do not announce the facts that point to a possible prevention of hydrophobia without some apprehension. Had I had sufficient material means, I should have preferred not making this communication till I had solicited, by the kindness of some of my associates of the Academy of Sciences and the Academy of Medicine, the verification of the conclusions I have just made known; and I have requested M. Faillières,

Minister of Public Instruction, to appoint a commission to which I may submit the dogs I have rendered insusceptible to rabies.

The crucial experiment which I should try at the first opportunity would be to take from my kennels twenty dogs insusceptible to rabies, which should be put in comparison with twenty other dogs. The forty dogs should be caused to be bitten successively by rabid dogs. If the statements which I have made are correct, the twenty dogs deemed by me insusceptible will all escape, while the other twenty will be attacked by rabies. In a second experiment, not less decisive, forty dogs would be used, of which twenty had been previously vaccinated, and the others had not. The forty dogs should be trepanned with the virus of a mad dog. The twenty vaccinated dogs would escape, and the other twenty would all die of rabies, with paralysis, or with mania.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE MORALITY OF HAPPINESS.

By THOMAS FOSTER.

CARE FOR SELF AS A DUTY.—(CONTINUED.)

IT will perhaps be sufficient, in response to numerous inquiries addressed to me respecting the supposed religious bearing of these papers, to remark that they are not intended to have any religious bearing whatsoever. I am simply inquiring what are the rules of conduct suggested when each person takes as his guiding principle the increase of the happiness of those around, an expression which must be taken as including himself in the same somewhat Hibernian sense in which Milton included Adam among "those since born, his sons." I may add that nearly all the letters addressed to me have been interesting, and some have been singularly well-reasoned—all utterly unlike the rather spiteful and very silly letters I referred to in a footnote to my last paper. Yet I can not suffer the religious element to be imported into the subject—no matter how courteously or kindly the thing may be done. I have just the same objection to see the question of the evolution of conduct considered from that side, which the student of astronomy or geology has against dealing with the objections and difficulties raised by those who seem always to suspect that under the teachings of God's work, the universe, there may lie some grievous deceptions if not some monstrous falsehoods. If my reasoning is bad, it can be met and overcome on its own ground.

I may, however, make this general remark with regard to all systems of morality whatsoever, including those which have come before men in company with religious teachings. Without a single exception

every one of these systems includes—and professes to include—features suitable to the special time and the special place when and where it was propounded. How much of any system may thus be regarded as local or temporary or both may be a moot point; but that some of each system is of that sort is absolutely certain. "Because of the hardness" of men's hearts the Mosaic system, for instance, had certain rules; and, because of the weakness of their hearts (who can doubt it?), the system which replaced that of Moses had certain other rules. The same is true of every system of conduct ever propounded. We may believe the rule sound and good in its own time and place, "Whosoever shall smite you on the right cheek turn to him the other also," and "If any man will sue thee at the law and take away thy coat, let him have thy cloak also." A man may believe these rules to be more than sound and good, to be of divine origin—yet recognize that in our own time, and here, in Europe or America, the rules would work ill. He who so taught recognized in the same way that other rules which had been good in their time had lost their virtue with changing manners. He knew *where* it is written, "Thou shalt give life for life, eye for eye, tooth for tooth," and so on; yet he only quoted these Scripture teachings to correct them—"But *I* say unto you, that ye resist not evil, but whosoever," etc. When he thus corrected what was "said by them of old time," he did not show disrespect—whatever the Scribes and Pharisees tried to make out—for the teachers of old time, whose words he read and expounded. He knew that "old times were changed," and therefore old manners and morals gone. He said, "Suffer little children to come unto me," and loved them, *not* teaching—as had seemed more convenient and was (let us believe) better, in earlier days—that the child would be spoiled unless diligently belabored with the rod.

These times and the races and the nations now most prominent on the earth are even more unlike the community in Palestine nineteen centuries ago, than that community was unlike the Jewish people in the days of the more ancient lawgiver. The opponents of evolution may prefer to believe that the human race has been stereotyped; but facts are a little against them. And even if we admitted the imagined fixedness of the human race for nineteen centuries, they would still have to explain the contradiction between two systems for both of which they find the same authority. Of course, there is no real or at least no necessary contradiction. Grant the human race to be what we know it to be, a constantly developing family, and the contradiction vanishes—we simply learn that what is best for one time is not best for another, even among one and the same people; how much more, then, must the best rules of conduct vary when different peoples as well as different times are considered!

All this, however, is a disgression, which should have been unnecessary, but has in a sense been forced on me by the misapprehensions of

many well-meaning critics (and a few who are not well-meaning at all, but of the Honeythunder order, teaching the law of love by reviling and worse).

The duty which each man owes to himself in regard to the maintenance of his health, the development of his powers, and so forth, which becomes a duty to others when regarded with reference to those more immediately around him or dependent upon him, and is still manifestly a duty in relation to others where the advancement of the general well-being, so far as he can influence it, is considered, has another aspect when considered in reference to those classes (D and E) * whose encouragement or increase would be injurious to the body social. It is not only essential to the evolution of conduct in the right direction that those who may be classed as "men of good will" † should increase relatively in number and influence, but also that those who are either absolutely men of ill-will, or are so far not of good-will that they disregard the well-being of others, should be checked and discouraged.

This requirement for the evolution of the more altruistic kind of conduct involves in many cases—as a duty—conduct of a kind which the few real members of Class A and the many members of Class C who speak of themselves as belonging to Class A—regard as self-assertive. It becomes a duty, when the matter is viewed in this light, to assert just rights and resist wrongful claims. For, every act of carelessness or self-neglect in such matters tends to the encouragement of the less valuable or noxious classes which profit by it. It may be that to uphold just claims or resist wrong-doing may be less comfortable than to give way. In such a case the duty becomes an altruistic one, however egoistic the action based on the consideration of such duty may appear. But in a number of cases the claim upheld may be well worth upholding in itself, the wrong resisted may involve gross injury. In such a case the care of a personal right or the resistance of a wrong is, in itself, egoistic. Yet may it well be that the person concerned may esteem it better to give up the claim or to yield to the wrong, until he recognizes that the idea of self-sacrifice, however beautiful in itself, may involve a far-reaching wrong to the better members of the body social.

We touch here on considerations which are in question every day, almost every hour, of our lives.

Consider home-life, for example. In nearly every home there are those who are disposed to take unfair advantage of the rest; and they are far better restrained by the quiet resistance of their attempts than in any other way—certainly far better than by yielding, continued till

* See "Popular Science Monthly" for May, p. 109.

† It may not be generally known outside the Roman Catholic community that the message rendered in the authorized version of the New Testament "Peace and good-will toward men," is otherwise rendered "Peace to men of good-will." The revised version reads "Peace among men in whom He is well pleased," which would in effect be nearer the Roman version.

nothing but the anger roused by some attempt, more barefaced than the rest, moves to resistance. We see this especially exemplified in the families of careless parents—unselfish perhaps in a sense, but really negligent of their duties. It has been said for this reason that unselfish parents have commonly selfish children, which seems contrary to the law of heredity, but illustrates rather the natural influence of defective training. The fact really is, that the children of selfish parents are as a rule more selfish in character than those of the unselfish; they grow up to be as unpleasant in their ways as the children of careless, unwatchful parents; and their unpleasantness is more apt to be permanent. Yet the unchecked ways of children whose parents yield unwisely to them, illustrate well on a small scale (even though happily the mischief is often transient) how the assertion of just claims, and the restraint of wrong-doing, involve a form of egoism which must be regarded as a duty.

In life outside the family, we constantly find the duty of resisting evil presenting itself in apparently egoistic aspect. In hundreds of ways the members of Class C show their readiness to become members of Class D and members of class D to develop their unpleasant ways. The adoption of considerate habits and care for the just claims of others in all the multitudinous details of our daily life, constantly lead to attempts by the selfish and obnoxious to take advantage of what they regard as mere weakness of disposition. In such cases, while it is by no means desirable to give up ways which are in themselves essential to the well-being of the society of which we form part, we must—as a duty—resist the encroachments of objectionable persons—not the less that the matter insisted upon is one to which we attach importance, so that our firmness has its egoistic aspect. Men are but children of a larger growth, and there is no surer or better way of eliminating at least the grosser forms of selfishness than by so resisting unjust claims that they—simply fail. This is the appropriate punishment—akin to that which Mr. Spencer regards (most justly in my opinion) as the only proper form of punishment for children, viz., punishment which is the direct consequence of ill conduct. Of course, it will happen that mere resistance of a wrong may bring definite punishment—directly or indirectly—to the wrong-doer; but (apart from such cases, in which we have to ask whether justice may not need to be tempered with mercy) all I would insist on is that the selfish, grasping, oppressive members of the body social should be so resisted that, whenever it is possible, they fail of their unfair purpose.

The rule applies in small matters as well as great. Mr. Spencer himself notes (though it is when dealing with selfishness specifically) a case of not infrequent occurrence, and perhaps of a trifling enough kind—the acted falsehood of railway-passengers who, by dispersed coats, make a traveler believe that all the seats in a compartment are taken when they are not. Here the detection and resistance of an

attempted wrong, contemptible as it is, may excite some sense of shame in the wrong-doers, though conceivably not (for such wrong-doers are of a shameless sort); but the defeat of their purpose will at the least involve disappointment and serve as a discouragement from such attempts in the future. Of course, a very zealous opponent of the obnoxious section of society might not be content with what I here advocate as the simple line of duty in such cases. He might (as an earnest opponent of evil did—rather harshly I think—the other day) take on himself to punish as well as to resist evil; and having been met with the customary falsehood as to some article deposited in a vacant seat, might pitch it out of the window, with the remark that he would be responsible to the real owner when he appeared. But this is going beyond the strict line of duty in such matters.

It will appear manifest, I think, on careful consideration of the matter by any one who notes, for a few days or even hours, the course of events around him in his family and in society, that he who neglects to defend his own rights against the encroachments of Class D as well as of Class E, and of Class C as well as of Class D, fails as clearly in his duty to the social body as the parent who overlooks selfish and unruly conduct in his children. And just as the children themselves whose training is thus neglected have really just reason, did they but know what is good for them, to complain of such mistaken kindness, so even the more selfish (all but the members of Class E) have no less reason than the unselfish, did they but know their own interests, to desire that considerate but firm and self-regardful conduct should prevail throughout the body social.

It has been shown that care of self necessarily precedes care of others, because we must ourselves live if we are to benefit others. It has been shown further that if there is to be progress and improvement in the race, the superior must profit by their superiority, and so develop in numbers and influence, while the inferior because inferior become less and less predominant in the community. Further, it has appeared that while a society improves as it becomes constituted more and more largely of the better sort, this improvement depends in large part on those qualities of the individual members of society which depend on due care of self. In like manner it appears that in a society whose members are not duly regardful of self, misery arises from the excess of self-denial which ends by making those who practice it burdens on the rest of the community. Lastly, we have seen that due care of self is desirable, and neglect of the just rights of self injurious to the social body, because that undue care of self which is properly called selfishness, and leads either to negative or positive forms of wrong-doing, thrives and multiplies in a community where the better sort allow evil and oppression to pass unchecked by the due assertion of self-rights.

But now it is worth remarking that the line of reasoning which has

been followed does not in reality indicate changed conduct. It reconciles the actual conduct of the better sorts of men with rules derived from observed facts and laws in regard to the development of conduct, and would tend to reconcile their conduct with their words, if men in general would but recognize the folly and danger of a system by which they have one set of rules on their lips and another for their actual guidance. As Mr. Herbert Spencer well puts it, the general conclusion to which we have been led, "though at variance with nominally accepted beliefs, is not at variance with actually accepted beliefs; while opposed to the doctrine which men are taught should be acted upon, it is in harmony with the doctrine which they do act upon and dimly see must be acted upon. . . . The laborer looking for wages in return for work done, no less than the merchant who sells goods at a profit, the doctor who expects fees for advice, or the priest who calls the scene of his ministrations a 'living,' assumes as beyond question the truth that selfishness, carried to the extent of enforcing his claims and enjoying the returns his efforts bring, is not only legitimate but essential. Even persons who avow a contrary conviction prove by their acts that it is inoperative. Those who repeat with emphasis the maxim, 'Love your neighbor as yourself,' do not render up what they possess so as to satisfy the desires of all as much as they satisfy their own desires. Nor do those whose extreme maxim is, 'Live for others,' differ appreciably from people around in their regards for personal welfare, or fail to appropriate their shares of life's pleasures. In short, that which is set forth above as the belief to which scientific ethics lead us, is that which men do really believe, as distinguished from that which they believe they believe—or pretend they believe."

Which is better?—to proclaim with our lips rules of conduct which none of us really follow, and to denounce those who show that the rules which the best-minded among us really strive to follow are such as tend most to improve the condition of the body social, or frankly to recognize the just and equitable rules of conduct which after all are the real guides of the actions of all well-meaning men? Is it well or wise to discredit these fair and proper rules by setting up others which seem more self-sacrificing, but which none except a few abnormally-minded persons of no influence (objects of ill-concealed contempt among those who applaud such rules) actually strive to follow—rules, moreover, which if widely followed would inevitably bring misery on the community? For my own part I believe that the system by which rules no sane man follows are set up as the real laws of conduct, works most serious mischief, by discouraging many from the attempt to be consistently fair and just to those around them as well as to themselves. Of what use, they feel (rather than consciously think), is any attempt to be merely just and considerate, when still we fall far short of the standard set up for our guidance? Apart from this lies the direct mischief to character which necessarily arises from

the confident expression of acceptance of rules which every man (except the few abnormal creatures I have mentioned) knows well that he does not follow, has never attempted to follow, and never intends to follow. Many are led, through their honest unwillingness thus to falsify their words by their actions, into an error of the opposite kind; preferring rather to maintain rules of conduct which have a selfish aspect, while their actual conduct is unselfish, than to ape a degree of disinterestedness which they do not possess, and which would (they know) be mischievous if really possessed and acted upon by any large proportion of the community.*

But, lastly, let it be noticed that just care for self does not imply necessarily less care for others, but often more. As a mere matter of fact, men who carefully consider their own just claims are found to be more considerate, as a rule, of the claims of others, than those who assert that men ought not to be careful to consider what their just claims are. Horace long since, in his famous ode beginning "*Justum ac tenacem propositi virum*," drew attention to the connection commonly existing between justice and firm maintenance of what is due to self. Of course, there are men who are unduly regardful of self, not being content with the maintenance of their own rights, but willfully infringing the rights of others. Equally are there some who while negligent of their own rights are considerate of those of others. But these are the exceptions. As a rule one may recognize in *due* regard for self-rights the same principle which displays itself otherwise in care for the rights of others. Considering social as distinguished from individual opinions, assuredly Mr. Spencer is justified in what he says on the egoistic excesses which often accompany excessive altruism: "A society in which the most exalted principles of self-sacrifice for the benefit of neighbors are enunciated, may be a society in which unscrupulous sacrifice of alien fellow-creatures is not only tolerated but applauded. Along with professed anxiety to spread these exalted opinions among heathens, there may go the deliberate fastening of a quarrel upon them with a view to annexing their territory. Men who every Sunday have listened aprovingly to injunctions carrying the regard for other men to an impracticable extent, may yet hire themselves out to slay, at the word of command, any people in any part of the world, utterly indifferent to the right or wrong of the matter fought about. And as in these cases transcendent altruism in theory co-exists with brutal egoism in practice, so conversely a more qualified altruism may have for its concomitant a greatly moderated egoism.

* It is, by-the-way, rather remarkable that in proportion to the apparent zeal with which some maintain the doctrine of universal love is the intensity of hate which they express and doubtless feel (being in this at least, let us hope, honest) for those who differ from them. If the Honeythunder School of Philanthropists act seemingly on the principle, "Curse your souls and bodies come here and be blessed," these seem to adopt as their rule, "Let us hate with all our might those who will not allow us to love every one better than ourselves."

For, asserting the due claims of self is, by implication, drawing a limit beyond which the claims are undue; and is, by consequence, bringing into greater clearness the claims of others."

We have next to consider the duty of caring for others, as it presents itself in connection with the morality of happiness.—*Knowledge.*

DISEASES OF PLANTS.

By D. P. PENHALLOW,
LECTURER IN BOTANY, MC GILL UNIVERSITY, MONTREAL.

STUDIES in vegetable pathology are by no means a recent development of science. So long ago as 1795, Schreger * issued a work treating of the various diseases then known, the work being in reality a compilation of the literature of the subject, which, up to that time, had been very much scattered. Then came a rather wide gap, until in 1833 Unger issued his work entitled "Die Exantheme der Pflanzen und einige mit diesen verwandte Krankheiten der Gewächse." From that time until the present we find the well-known names of Meyen, De Bary, Sorauer, Hartig, Frank, and others linked with a tolerably copious literature on this subject. We find the Germans among the first, if not the very first, to recognize the desirability of pursuing questions of this kind from a scientific stand-point, though, aside from purely scientific considerations, these questions were forced upon the general attention of the country from an economical stand-point. It was recognized that the important interests involved in forest-growths were liable to be seriously impaired through the operation of disease, and that, even were this not the case, the interests involved could be most fully protected by the development of that knowledge which should secure the best oversight and care of forests in all respects. A wise policy, therefore, dictated the establishment of forestry stations, the duties of which included a study of the various diseases affecting trees.

In America hardly a serious thought has yet been given to such considerations, so far as they extend to the protection and preservation of our forests; but it seems probable that the movement to protect our forests from ruthless destruction at the hands of man, which is each year assuming more tangible shape, must ultimately embrace also an effort to have our trees studied according to strict scientific methods, for the purpose of determining their relation to disease and protecting them from injury. But, while we find the question unconsidered from the exact stand-point which first developed in Germany, we do find

* Erfahrungmässige Anweisung zur richtigen Kenntniss der Krankheiten der Wald- und Gastenbäume, etc., Leipsic, 1795.

that it has been forced upon our attention in another and, for those immediately interested, more unpleasant way.

For the last hundred years or more, under the influence of the peculiar methods of cultivation which have been employed by our fruit-growers, various diseases have appeared from time to time in several of our important fruits, and to such an extent have some of them developed within the last ten or fifteen years that they have completely destroyed the fruit industry in some sections, and now threaten a more general annihilation of one of the most enticing and profitable occupations for the farmer. For the last hundred years we have heard of the "blight" in pear-trees, and the best records show unmistakably that the disease has been on the increase during that period. So badly is it developed in some fruit sections, as through Southern New York, that it is a matter of extreme difficulty to find a really healthy tree. For the last eighty years we have also heard of the "yellows" in peaches, and here again we find that history records a constant development of the affliction. So serious have its ravages proved that whole sections have been deprived of the very important industry of peach-culture. Not only this, but the disease is now so thoroughly established, and has come to be so much a matter of inheritance, that the life of the tree is greatly modified and even determined by it. The peach is naturally a long-lived tree, instances brought to my notice showing that it may live for upward of one hundred or more years, and, if well cared for, it will certainly produce fruit for a long period. At the present time, however, as in the great peach districts of Delaware and New Jersey, we find that, owing to the certainty of disease appearing, or the inherently weak constitution resulting from its previous operation, the period of a profitable life is limited to nine years, at the end of which time the trees are rooted out of the soil as worthless.

Twenty-five years ago the Hudson River Antwerp came into cultivation in Southern New York, and for a long time was a famous berry, and made money for those who cultivated it. Within a few years a disease has appeared, and to-day it is considered worthless to the fruit-grower. And so it is with others of our important fruits. Diseases are yearly becoming a more and more familiar foe for the horticulturist to deal with, and a great deal of alarm is felt, and with reason, lest the fruit industry in some directions be completely destroyed. Thus it is that within a few years it has become imperative that something be done, looking to the acquisition of facts which will enable us to successfully cope with these disorders, to ward them off or arrest their progress. Fortunately, the question is an important one, and so is yearly claiming more careful attention from scientific men.

Diseases arise from such a variety of causes, and are so various in their effects, that we can not judge them all from the few given as illustrations. Moreover, there seems to be such an inadequate concep-

tion of the nature and extent of these disorders in plants, as well as of their influence, that it seems desirable to present a general outline of the subject according to our present knowledge. We will, therefore, pass over a special consideration of the various scientific investigations of the last few years, and deal with the conditions under which the diseases develop, as well as some of the most important results of their action. First, let us briefly consider what constitutes a disease.

In the animal the system is considered diseased when the functions of the body cease to be performed in a normal manner, and the disease is more or less serious, according to whether one or more functions are involved, as well as the degree to which the impairment of a particular function is carried. In instituting pathological comparisons between animals and plants, we have to keep in mind that there are important structural differences and physical peculiarities which may favor the development of disease more in one case than the other. In animals the mass of their structure is composed of highly vitalized and actively growing cells and tissues ; while in the higher plants, where the differentiation of structure is carried to a high degree, there is a very considerable portion of the body which has become incapable of further growth, and is virtually dead. In many cases, as in trees, the permanent structure predominates, and the vitalized tissues are relatively few. Furthermore, through a delicate nervous system which penetrates the most remote parts of the body, the whole animal organism is brought into more or less active sympathy with the diseased portion, even though the disorder be one of a strictly local nature, while the blood as a general medium of circulation tends to distribute the affection and thus bring the entire system into a diseased condition. In the vegetable kingdom we find no fluid which would be strictly equivalent to the blood of animals and capable of disseminating disease through the organism in a similar manner. Recent researches by Hillhouse,* however, seem to strongly confirm the previous observations of Gardiner, Strasburger, Frommann, and others, that there is a well-defined continuity of the protoplasmic substance between adjoining cells through their walls, thus rendering it highly probable that, in plants, the protoplasm may act in a manner similar to the nerves of animals to bring somewhat remote parts into more or less active sympathy, and this consideration must have weight in the future, as giving us a more correct insight into the operation of disease and the possibilities of its complication.

If we clearly recognize that the physical basis of life is the same in both plant and animal, and that it is through disturbance, primarily, of the protoplasmic functions that the functions of the organism as a whole are disordered, then from this and what has already been stated it becomes evident that the pathology of plants and animals is the

* Bot. Centralbl., XIV, 1883, pp. 89-94 ; Journal Royal Mic. Soc., Ser. II, vol., iii, p. 524.

same, chiefly involving greater degrees of complexity in the latter, and that we must apply the same principles for the recognition of disease in each case. This view was expressed so long ago as 1846,* and receives confirmation in the expressions of some of our best pathologists of the present day.† Frank ‡ tells us that "disease is every deviation from the normal condition of the species"; while Sorauer ‡ says, "We must recognize as a disease every disturbance of the organism which detracts from the final end of its labor, the accomplishment of its purpose."

In considering the diseases of plants, it is important to bear in mind that we have to deal with subjects which on the one hand are cultivated, and on the other hand not. In forest-trees there has been no modification through cultivation, and disease would not be likely to become complicated from this cause. In cultivated trees, and plants, as in the peach, pear, strawberry, raspberry, etc., a high degree of cultivation has resulted in a corresponding modification upon which the pecuniary value directly depends. This strong divergence from the original type involves a debility in one or more directions, and is quite parallel with the changes known to occur in more highly civilized communities of men, by reason of which diseases are not only likely to be more prevalent but more complicated. This analogy, as well as general principles, would show us that the more highly cultivated the varieties of fruits or plants, the more susceptible are they to the influence of environment with the introduction of disease, and this is confirmed, not only by personal observation, but by the experience of practical fruit-growers.

Again, cultivated fruits always tend to revert to the original form when the conditions of their high state of development are withdrawn. Moreover, such organs often show that this excessive development has obliterated, wholly or in part, those important functions connected with the reproductive processes which they were originally designed to fulfill. These are some of the evidences that all such monstrosities as our modern apples, pears, strawberries—in short, all our cultivated fruits—are in reality abnormal growths which we may designate as hypertrophied structures, and are therefore evidences of disease. In such cases, therefore, the questions of treatment are likely to become somewhat complicated, since, while maintaining a certain form of disease, we must exclude, prevent, and cure all others.

Diseases may be general in the system, or they may be localized, and this is a consideration of obvious importance when we bear in mind that, according as they are one or the other, they may be more or less destructive in their effects or be controlled with greater or less difficulty. When a disease involves the entire system, as in peach-yellows or pear-blight, it is often a matter of great difficulty to deter-

* Smee on "The Potato Plant."

† "Lancet," 1880, vol. ii, pp. 605, 645.

‡ "Krankheiten der Pflanzen," p. 2.

‡ "Handbuch," p. 56.

mine the controlling treatment; but in other cases, where the disorder is strictly of a local character, it may be a simple matter to remedy the trouble. In the case of those peculiar developments of the oak which give us the gall-nuts of commerce, or of similar abnormal developments in the tissues, we have instances of well-defined disease, but it is of a strictly local nature; the disturbance of functional activity does not extend beyond very narrow limits. It becomes, then, a simple matter to treat the case, because the part may be removed without inflicting injury upon other organs of the plant, and thus the knife is the sure remedy. Or, again, certain diseases may originate in the breaking of a limb or the fracture of a surface tissue. In such cases the disease will follow the injury and progress slowly, but it is often a simple and easy matter to prevent its introduction into the general system by properly caring for the wounded part in the first instance. Nature herself provides the means of warding off disease in just this way, and within certain limits her provisions are most effective. If a structure such as a vigorously-growing plant be injured, there at once appears a clear fluid, which gradually thickens into a mucilaginous substance, and finally becomes dry and hard. Under its early protection, a tissue of cork is formed over the wound as a healing and protective structure, impervious to air or water. Under it, the injured parts, now excluded from the air, are able to perfect the healing process by the formation of new tissue.

In plants, as in animals, diseases may be developed through a great variety of causes, but it is possible to bring them into a rude system of classification by means of which their consideration is greatly facilitated. The best arrangement of the kind which we have at present, one which answers very well, is that of Hartig,* according to which diseases are developed through the action of—

1. Phenogamic plants.
2. Cryptogamic plants.
3. Injuries.
4. Soil influences.
5. Atmospheric influences.

Under the first head we have to deal with those plants, like the mistletoe and dodder, which grow upon others and draw their nourishment directly from them—hence are truly parasitic. Plants of this kind may contain a certain amount of chlorophyl, but usually possess no true roots; hence they are not only incapable of drawing nourishment directly from the soil, but they are also incapable of performing the assimilative functions by which materials for the formation of cellular structure are developed, in more than a limited manner if at all. Such plants, therefore, must depend entirely upon the already elaborated sap contained in their hosts, and, feeding exclusively upon this, the latter must suffer in a degree which is proportional to the devel-

* "Lehrbuch der Baumkrankheiten," p. 6.

opment of the parasite. The tissues in which the latter feeds must thus become diseased, primarily through lack of nutrition, and so finally develop in an abnormal manner, as is seen to be the case in the often enormous knots which accompany the growth of the mistletoe upon the oak. Such excrescences often reach a diameter of three or more feet. A secondary feature of such diseases is then developed in the readiness with which such hypertrophies often yield to decay, or in the decay which is introduced into the various tissues of the host wherever the parasite penetrates. It is evident that diseases of this character may be, and usually are, of a strictly local nature, and, in the early stages at least, it is easy to remove both the disease and the cause by amputation. When local action has been long continued, however, the highly morbid condition of a limited portion of tissue may in time find sympathy in adjoining parts, and so by degrees the whole system become involved in a chronic disorder. We may thus remove the cause, but additional treatment will be essential to restore the system to its normal condition.

In the second class of causes we have the cryptogamic parasites, or, more properly, the saprophytes, to contend with. These plants, like the parasites proper, are incapable of providing their own nourishment from the soil and air, and so must depend for their growth upon already-formed organic matter. But this is not all: it is characteristic of their growth that they live upon organic matter which is in an active state of decomposition, and it will thus be easy to see that they are not far removed from being the cause of the decomposition in bodies which have already ceased to live. In their action upon non-vitalized matter, it is quite possible that they are the active promoters of disorganization; but the case is somewhat different with the living organism. Here the growth of the saprophyte has to contend with the vitality of the host, and, so long as this latter is normally maintained, it is most probable that the intruder will fail to gain sufficient hold to exert any appreciable injury. But the struggle continues, and if, by reason of accident or peculiar conditions of environment, the vitality of the host be reduced below certain limits, then the saprophyte or parasite, as the case may be, at once exerts a preponderating influence which is highly deleterious. Or, again, if the plant be diseased through the operation of other causes, then the fungus can exert its influence to produce secondary features of an already disordered condition. These views find confirmation in the general action of fungi upon tissues. It is observed that they are more or less abundant in the rough outer bark and on the surface of most plants; but, though they are present, their growth is limited, and confined to those tissues which are either dead or of very low vitality, while the plant suffers in no wise from their presence. Let the plant be injured or diseased, however, and at once the parasite gains a firmer hold, the tenacity of which will increase continually until remedial measures are applied. Thus, we

often find the breakage of a limb to be but the open door by which rot is introduced into the interior tissues. We may consider, however, that with most of the mycelial forms of fungi their action is more or less localized, as in the smut of corn (*Ustilago maydis*), or the disease called cedar-apples (*Gymnosporangium Sabinæ*), or the curl of the peach-leaf (*Exoascus deformans*). So far as they are localized, therefore, their treatment is a simple matter, since it only involves cautery or removal of the affected part. Owing, however, to their peculiar habits of growth, and the insidious rapidity with which the spores may be disseminated, they may cause a disease of the general system when the conditions of the latter are favorable. But it is not such an easy matter to dispose of all these organisms. In the animal, it is now well demonstrated that disease may be directly produced by the action of certain schizomycetes, such as the micrococci and allied germs; and it is even claimed by some that they have a corresponding pathogenic function in the vegetable organism. These latter views, however, rest upon insufficient evidence at present; but, in considering certain diseases of plants at least, analogy would dictate measures of caution in formulating an opinion which wholly disregards the importance of these minute structures as pathogenic agents. Whether actually the cause of disease, or only of secondary features, in either case they are most difficult elements to deal with.

The third class embraces a variety of causes which may be directly controllable by man or not. Injuries may be inflicted by insects, as so generally occurs in the formation of galls upon leaves; in the punctures which various boring insects, as the *scolytus* and *ægeria* make for the deposition of their eggs; and, more especially, as in the subsequent action of the larvæ. There are, also, injuries which may be inflicted by animals and man, either by accident or design, and which permit the operation of fungoid growths with the development of secondary features. All these are of a strictly local nature, and the question whether or not the entire system will be involved in disorder must largely depend upon the extent and nature of the injury in the first instance.

The treatment may or may not be difficult. Where insect action is strictly local, as in galls, the amputation of the parts is sufficient; but, where the injury is inflicted by boring larvæ, the grub must first be destroyed, and this requires certain knowledge of the habits of these insects in the different stages of development. In the case of the scolytid borers the treatment is especially difficult, as the beetles are very small, and hard to destroy; but it is an interesting fact that the ovipositing of these insects is in itself indicative of an already diseased condition,* so that the surest and best remedy is a

* Professor Riley tells me that, so far as he knows, these borers oviposit *only* in diseased trees, though they may feed on healthy trees; and, in my observations of the last two years, I have been unable to collect a single fact opposed to this view.

complete destruction of the plant or tree, together with the borers, by fire.

Where injuries are inflicted by man, proper attention in caring for the injured part will prevent the introduction of disease. Nature provides means for the healing of injuries produced in this way, and in many cases it is possible for very extensive injuries to be healed without any aid beyond Nature's own efforts. Grape-vines and other vigorously growing plants often exhibit a most remarkable recuperative power. One of the most notable instances of this kind was brought to my attention in 1874.* During the early spring the bark of a weeping-willow was removed from the base of the trunk, making a complete girdle for a distance of eighteen inches from the ground. In some places the cambium tissue was not fully destroyed, and this materially aided in the healing process. From the upper part of the girdle, or, more properly, from the lower portion of the uninjured bark, a new growth was rapidly formed and pushed downward, soon taking the form of aërial roots. In one or two instances these became more or less connected with the trunk over the girdled portion, but most of them remained distinct, and all finally penetrated the soil, with which they established a normal connection. In another instance, when removing some young squashes from vines under experiment, the former were separated by a knife, but left in place for collection at a later time. One, however, was overlooked at the time of collection, and, when the final harvest was made, it was discovered firmly united to the stem from which it was originally separated, and had attained considerable size. Upon careful examination of the parts, both externally and under the microscope, it appeared that—1. When the cut was made the squash was not displaced, and the cut surfaces immediately came together again. 2. As determined by a "fault" in a crack of the epidermis, the squash rotated in position as the cut was made, thus accomplishing a displacement of nearly one quarter of an inch on the surface of a stem three quarters of an inch in diameter. 3. The healing was complete in the interior of the stem, but the line of section was plainly visible under the microscope. 4. The union of the epidermis and tissues immediately below was not accomplished, and there was thus left, by shrinkage of the parts, a groove which extended completely around the stem and demonstrated the completeness of the section in the first instance.

In these examples, therefore, we have illustrations of the inherent tendency of all plants to overcome disease and injury through the operation of vitality.

In soil influences we have to contend with conditions which are not always so easy to control, and, when once they have produced their effect upon the plant, the diseased condition is a somewhat difficult matter to correctly diagnose and treat. Soil influences operate in a

* "Phenomena of Plant Life," Clark.

variety of ways; it may be through excessive humidity, as determined by the stagnation of water through imperfect drainage, or the natural condition and position of the water-table, or it may be through the mechanical condition. While these conditions may not actually cause disease, they will certainly promote it when once developed, and we therefore find a certain part of remedial measures to consist in thorough drainage and cultivation. But more than this, we find in special or general exhaustion of the soil a fruitful source of disease. Lands which have been cropped for a long period become at least specially exhausted, and in such case usually in the direction of that food-element most essential to the growth of the plant which has brought about the exhaustion. There is thus developed a debilitated condition of the entire system, by means of which the normal functions are impaired, and this in itself constitutes a disease. But the debilitated state permits the operation of other forms of plant-life which would otherwise be unable to develop readily, and also allows certain abnormal physiological and chemical changes to occur, all of which promote secondary features and thus bring about complication. This, it seems tolerably certain, is the case in peach-yellows, and may also prove to be the case in other diseases such as pear-blight. Diseases developed in this way, however, are most difficult to treat, because the entire system is involved. Remedial measures must therefore be directed toward—1. Removing the cause; 2. Building up the general system; 3. Restoring to a normal condition the disordered organic function. In the case of peach-yellows, the results of chemical analysis, as well as the changes produced by special treatment, show that in all probability the specific is chlorine as contained in muriate of potash, while a general toning of the system may be accomplished by the judicious application of a complete food as determined from the ash composition.

Atmospheric conditions are largely, if not wholly, beyond the control of man. They include, of course, the varying conditions of heat and moisture, and are thus either highly stimulating and favor the excessive growth of weak structure and parasites, on the one hand, or they are depressing and cause a stagnation of vital activity, and thus injure the plants, as through excessive drought; while this, in turn, leads to the development of parasites, which would not otherwise gain a firm hold. We can not expect to modify the conditions which produce these results; we can only hope to so prepare the plant, by judicious treatment, that it will suffer no material injury from the peculiar meteorological conditions in which it is placed. With this in view, we would doubtless find it wise to apply strong food, which will retard the vegetative process, and tend to the more solid maturity of the parts already formed. Nor must we neglect the importance of a judicious course of irrigation during drought. Doubtless the time will come when every man who depends upon the growth of plants for his living

will recognize a well-devised system of irrigation, which may be applied to all his orchards and cultivated fields when necessary, as an indispensable part of the machinery which a successful business demands.

The conditions which produce disease in plants, as well as the direct and secondary effects of their operation, are likely to be more or less complicated, and thus render a direct course of diagnosis and treatment correspondingly hard to reach and apply; but we can hardly form a correct estimate of these difficulties by analogy with a disordered condition of the animal. We have, at the outset, structures of widely different organization, which not only depend upon very different conditions of nutrition, but which are placed in widely different conditions of environment other than this. On the one hand, we have forms which, once developed, occupy a definite position, and their relations to environment—soil conditions, food-supply, etc.—are in a measure fixed. On the other hand, we have more highly organized bodies, which are continually changing their location, and they are thus brought into new relationships, to which they must adapt themselves, and this is liable to complicate the phases of disease already present. I think it will appear, however, that—at least in many cases, especially where nutrition is chiefly involved—we must apply the same general principles in the one case as in the other.

It was shown, not long since, by my friend Dr. Goessman,* that in certain cases of disease the normal and abnormal conditions are correlated to the presence of relatively greater and less quantities of certain food-elements. This was demonstrated by chemical analysis of the diseased wood or fruit, the naturally healthy structure, and, again, the diseased structure after being restored by a course of treatment which involved an application of the elements supposed to be wanting. In the case of the peach-yellows, concerning which we have the fullest data, he found the potash to increase in the healthy and decrease in the diseased; while the lime decreased in the healthy and increased in the diseased; and furthermore that, under treatment, the appearance of greater or less quantities of potash was reciprocal with similar changes in the lime present. The following analyses will show this relation:

CRAWFORD'S EARLY PEACH.

FRUIT.	Healthy.	Diseased.
Ferric oxide	0·58	0·46
Calcium oxide	2·64	4·68
Magnesium oxide	6·29	5·49
Phosphoric acid	16·02	18·07
Potassium oxide	74·46	71·30
Total	100·00	100·00

* "Transactions of the Massachusetts Horticultural Society, 1882."

BRANCHES.	Healthy (restored).	Diseased.
Ferric oxide	0·52	1·45
Calcium oxide	54·52	64·23
Magnesium oxide	7·58	10·28
Phosphoric acid	11·37	8·37
Potassium oxide	26·01	15·67
Total	100·00	100·00

It has further been shown by myself * that in some cases of disease, notably the one just referred to, there are important modifications of cellular structure and cell-contents as typical of the pathological condition. The growth becomes depauperate as a whole, and also in the various anatomical elements of the structure. At the same time the foliage assumes an abnormal color, and fails to perform its functions in the assimilative process. Yet, again, with reference to the storage of assimilated material, there is often an abnormal accumulation of such elaborated food in parts where it should not appear, except in limited quantity.

All these conditions in the case of peach-yellows are coincident with the development of the peculiar chemical conditions as noted above ; and it is further a most interesting fact that, while the excess of lime and want of potash occur together with depauperate structure, loss of color in the foliage, and excessive storage of starch, an increase of the potash and decrease of lime occur simultaneously with a disappearance of these various abnormal conditions.

We are now led to inquire as to the proper course to pursue in making a diagnosis.

When the disease is strictly localized, as when produced by injuries, or by the action of parasites proper; when the local disturbance is of sufficiently recent origin to render it improbable that the general system has become involved—then the diagnosis is in most cases a simple matter, and chiefly involves the correct recognition of the cause of the disturbance—i. e., the name and character of the insect or parasite, or the particular means by which the injury was first inflicted.

When the disease involves the entire system, and the conditions become more complicated, then the difficulty increases. A correct and complete diagnosis can then be made only when we consider—

1. The chemical composition in health and disease.
2. The internal features, including the—
   (*a*) Cellular structure.
   (*b*) Cell-contents.
   (*c*) Presence of fungi in the cells.
3. The external features, embracing the—
   (*a*) Color and size of the foliage.

* "Transactions of the Massachusetts Horticultural Society," 1882.

(*b*) Color and general condition of the bark.
(*c*) Character of the new growth.
(*d*) Condition of the fruit.
(*e*) Presence of parasites.

We can not hope to correctly determine the nature of diseases by seeking new light upon strictly botanical grounds alone—e. g., by assuming that they originate more or less directly in fungoid growths. Nor can we hope to get at the origin and cure of these disorders from a purely chemical stand-point. The two lines of inquiry must be followed together until they merge in one harmonious result. In such manner alone may we hope in the future to solve the difficult problems now awaiting the patient student, to whom they will bring abundant reward.

These thoughts are offered as a mere outline of the direction which such considerations in vegetable pathology are now taking, and of the form they have already assumed.

ADAPTATION TO CLIMATE.

By Dr. A. BERGHAUS.

ANIMALS and plants are fitted by their organization to adapt themselves to many changes of place and vicissitudes of climate. Most of the domestic plants that are cultivated in the north originated in southern regions. The trees of the orange family were not cultivated in Italy in Pliny's time. The citron was not raised there with success till the third century; and lemons and oranges, which now grow in Southern Tyrol, not till later. The mulberry, which has now made its way to Norway, likewise did not flourish in Italy when Pliny wrote. Juicy peaches were not grown in Greece in the time of Aristotle, and even in Rhodes the blossoms only developed into a thin, woody fruit; but the peach-tree, bearing choice fruit, is now common through all France, and in the gardens of Central Germany. Chestnuts, originally at home only in warmer Asia, are now equally so in Italy and Western Germany. Some plants, notably the cereals, have enjoyed a very extensive diffusion in the course of centuries, and are now cultivated in nearly every part of the habitable earth. Our domestic animals, which mostly came from Asia, have gone with man to all the quarters of the world; and it is worthy of note that it is just those cereals and domestic animals that have proved themselves most useful to man, and are essential to civilized life, that pre-eminently possess the faculty of adapting themselves to all climates, and of producing the most diversified varieties.

The power of adaptation to climates appears to be most highly

developed in man. He is less than any other being bound to any particular zone, and is further suited to the widest diffusion, because, confined to no especial food, he is, in the fullest sense of the word, omnivorous. He is, not only by the organization of his body, but especially by his mental power and his energetic will, fitted above all other creatures to accommodate himself to the most various influences that can affect him from without, and by continuous habitude to endure or make bearable the strangest conditions. He can live at the extreme limits at which organic life can exist, and can sustain a degree of cold at which quicksilver freezes. Thus, three Russians lived for seven years in Spitzbergen without suffering in health. Admiral Wrangell, while in the Chuckchee country in 1820, experienced a cold of nearly 50° below zero, while his men were as lively and happy as if it had been summer; and Parry and Franklin withstood a still greater cold. Man can also sustain an almost incredible degree of heat. The celebrated physician, Boerhaave, believed that no being breathing with lungs could live in an atmosphere having as high a temperature as that of the blood. According to this dictum, one ought to die at a temperature of 100°, but Banks enjoyed good health on the Senegal when the thermometer rose in his cabin to above 120° and 130°. Men live on the southwest coasts of Africa, and in other hot regions, where the heat of the sand under their feet reaches 140° or 150°. Men in deep mining-shafts and under diving-bells are able to support an atmospheric pressure of 30,000 kilogrammes as well as a pressure of only 8,000 kilogrammes on the highest mountains. Cassini thought that no animal could live at a greater height than 4,700 metres, or 15,000 feet; but there are several inhabited places situated at a still greater height, as, for instance, Gartok, in the Himalayas. Alexander von Humboldt ascended Chimborazo to a height of nearly 6,000 metres, or 19,286 feet, without suffering any harm. The pressure of the atmosphere is so light at such elevations that, as Humboldt was assured, wild animals when driven up to them bleed at the mouth and nose. Only the dog is able to follow man as far and as high as he can go; but this animal, too, loses his acute smell in Congo and Syria, and the power of barking in Surinam and at great heights; and the finer breeds of dogs can not long endure the conditions of a height of more than 3,760 metres, or 12,500 feet, while there are towns in the Andes at as great a height as 13,500 or 14,000 feet.

But there are regions in which even man perishes, to whatever race he may belong, and however well prepared he may be to resist their deadly influence. Among such regions is the Gaboon valley, in which even the negro is disabled. The inhabitants of that district are decidedly weaker in constitution, and have greatly diminished reproductive powers, and the women are considerably in excess. There are similar regions nearer the centers of civilization. The Tuscan Maremma is famous for its deadly air, and the swamps of Corsica are of like

character. In France the ponds of the Dombes and the mouth-country of the Charente were, till recently, no less dangerous. Life in great cities also seems to exercise a special influence on reproduction. Boudin could not find any pure Parisians who could trace the residence of their ancestors in the city back for more than three generations. In Besançon the "old families" generally die out in not quite a hundred years, and are replaced by families from the country; and the same is, to a greater or less extent, the case in London, Berlin, and other large cities.

Has it been proved that on ships, where men are crowded together for months under conditions incompatible with health, particular disorders are developed, to which sailors may, indeed, gradually accustom themselves, but which are apt to mature into fatal maladies among people hitherto in perfect health? Can we, as Darwin suggests, ascribe to such circumstances the fearful mortality and the diminishing fruitfulness of the Polynesian races? Does the consumption which has become epidemic and hereditary in those islands belong to the diseases that have insinuated themselves there by the aid of European sailors? Neither the land nor the sky has changed since the Polynesian archipelagoes were discovered; yet the aboriginal population is diminishing at a really frightful rate, while its bastard offspring and the pure Europeans are increasing rapidly.

To what extent the more or less pronounced dangerousness of a locality is affected by normal conditions or by casual injurious influences is not always easy to estimate. The character of the soil, a higher or lower temperature, dryness, and moisture, are not all that determine the character of a country. We have evidence of this in the fact that the process of acclimatization is not equally easy in both hemispheres. The white races fare much better in the hot countries of the southern hemisphere than in the corresponding latitudes of the northern hemisphere. Between the thirtieth and thirty-fifth parallels of latitude lie Algiers and a part of the United States—regions in which the acclimatizing of Europeans is attended with great difficulties. In the southern hemisphere, the southern part of the Cape Colony and New South Wales lie between the same parallels, and in those countries white men thrive. French and English troops exhibit a rate of mortality eleven times as great in the northern as in the southern hemisphere—a striking difference, which appears to depend upon the greater frequency and intensity of miasmatic fevers. North of the equator these fevers reach in Europe to the fifty-ninth degree of latitude, while south of the equator they seldom extend beyond the tropic and usually do not reach it. Tahiti lies under the eighteenth degree of south latitude, and is free from fevers. French and English troops stationed in the southern hemisphere afford a mean of 1·6 per thousand sick with fever annually, while among those stationed in the northern hemisphere the proportion of fever-sick is 224 per thousand.

Thus miasmatic fevers are two hundred times more frequent north of the equator than south of it, notwithstanding that there are extensive regions in South America and Australia covered with standing water and exposed to a burning sun. To this may be added that attacks of fever are much less severe in the southern hemisphere. Only light fevers prevail in the great lagoons of Corrientes; how much more dangerous are the fevers of the Pontine marshes, which are, nevertheless, very far from the equator! A European can live with much greater security against the contingency of fevers on the banks of the Paraná, in South America, than on the banks of the Garigliano, in Italy.

There has been no lack of attempts and theories to explain these differences in localities that seem otherwise generally to stand under the same physical relations, but none of them have been successful. Yet it appears to be established that the greatest difficulties in the way of Europeans becoming acclimated in places where their business leads them to settle are due to the presence of swamp miasms. We know that a variety of conditions must combine to produce such miasms, and we know also that man is able to contend against them. It is possible for man to open a campaign against Nature wherever he goes, and to introduce conditions more favorable to his becoming acclimated. But he has so far not been able to bring a whole country immediately into a healthy condition; only time seems to be competent to bring such a work to completion, and, waiting its course, numerous victims have to be offered up.

The cultivation of the eucalyptus, a tree of remarkably quick growth, appears to be one of the most effective means now available for improving the condition of unhealthy localities. There are frequently tracts of limited extent in the most sickly regions where the process of acclimatization is relatively easy and secure. Such points should always be chosen by new settlers. The contrary has generally been the case. The beauty and fertility of the alluviums at the mouths of rivers, with the conveniences they offer to trade, have generally been tempting enough to determine the location of the settlement, regardless of its qualities with reference to health; and towns have been planted in such places in consideration of the apparent value of the money-investment, but in complete forgetfulness of the immense capital in human lives they are destined to swallow.—*Translated for the Popular Science Monthly from Das Ausland.*

GLASGOW'S BANDY-LEGGED CHILDREN.

By GEORGE HAY, M. D.

LAST summer the writer crossed the Atlantic and visited his native country, Scotland. His parents, now well advanced in years, were living in Glasgow, and he found himself at home. On the first Sunday after his arrival he took an extensive walk through the city, and, of course, observed the people, young and old, male and female. He noticed very few good-looking men or women in Glasgow. The men are, for the most part, short and squat, while the women are undersized, and anything but handsome. The people of both sexes physically differ entirely from the men and women of Edinburgh, who, as a rule, are straight and strong, well-featured and intelligent, and excellent examples of manly and womanly beauty. The principal industry of Glasgow—the building of iron and steel ships—demands a great deal of unskilled or rather of low-grade labor, and the ranks of the laborers are recruited from Ireland. Thousands of Irishmen are employed in this work, and earn very high wages—from twelve to fourteen pounds sterling in two weeks. The average riveter is a mere animal, given to eating, and drinking, and debauchery, and, as a consequence, despite his high wages, he is continually on the ragged edge of poverty, misery, and destitution. Of course, there are some exceptions to this general rule, and they soon become independent.

If, choosing some fine day when children are apt to be on the streets, we take a walk of a single mile in any direction in the city, we are sure to notice from fifty to one hundred children, between the ages of two and thirteen years, whose legs are deformed and distorted in ways which are remarkable, and to degrees which are really hideous. One would think that the whole juvenile population was suffering from rachitis or from osteomalacia. The lines in the annexed figures, in pairs, indicating the general contour of the leg and foot, will convey some notion of the deformities, of which hundreds of living examples may be seen on the streets of Glasgow. The short, straight lines, at the bottom of each pair, indicate the feet. It is generally the bones of the lower limb from the knee downward, the tibiæ and the fibulæ, which are bent in the manner indicated in the drawings, in which care has been taken to avoid exaggeration.

In addition to those here illustrated, examples may be seen of forward or backward, regular or irregular curvature, single or double curvature of one leg, with an outward or inward, regular or irregular, single or double curvature of the other leg. In short, the legs of Glasgow children may be seen twisted and distorted in every imaginable direction. Some of these deformities are painful to look upon, though

FIG. 1.—FRONT VIEW—OUTWARD REGULAR CURVATURE.

FIG. 2.—FRONT VIEW—INWARD REGULAR CURVATURE.

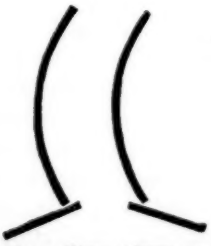


FIG. 3.—FRONT VIEW—OUTWARD AND INWARD REGULAR CURVATURE.

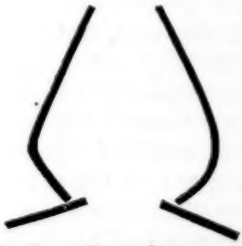


FIG. 4.—FRONT VIEW—OUTWARD IRREGULAR CURVATURE.

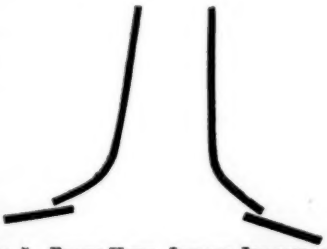


FIG. 5.—FRONT VIEW—INWARD IRREGULAR CURVATURE.

FIG. 6.—SIDE VIEW—FORWARD REGULAR CURVATURE.

FIG. 7.—SIDE VIEW—FORWARD AND BACKWARD REGULAR CURVATURE.

FIG. 8.—FRONT VIEW—DOUBLE CURVATURE OF BOTH LEGS.

from a professional point of view extremely interesting. The causes assigned by the people of Glasgow for the prevalent deformity are various, but none of them seem to account for it.

Let us consider the professional opinion first. Many of the physicians in Glasgow account for the rachitis, or osteomalacia, by laying

the blame upon the water which is supplied to the city. The water comes from Loch Katrine, the lake made famous by Sir Walter Scott in "The Lady of the Lake," and is very pure and soft, containing, if the writer remembers rightly, only about half a grain of solid matter in the gallon, which solid matter consists mainly of silicic acid and a little humus in solution. It is particularly free from the lime salts which go to the formation of bone; but, even though that is the case, such an attempt at explanation displays an astonishing amount of physiological ignorance on the part of those who make it. A half-ounce of bread, more or less, additional in the diet, would make up for all the difference between a soft and a hard water. The professional opinion may, therefore, be rejected as not pertinent.

Another explanation was suggested to the writer by the Professor of Physiology in the University of Glasgow, who thought the curvature of the bones of the children was due to the abandonment of oatmeal as an article of diet by people whose ancestors were accustomed to its use, and to the substitution of wheat-bread. This seemed to be a very plausible opinion. But it can be objected that, in many places where oatmeal is hardly ever used, rachitis and osteomalacia are comparatively rare. For example, in the United States oatmeal has been comparatively little known as a food, and yet very few rachitic children are to be seen. Similarly in Edinburgh, so far as the writer could observe, oatmeal is much less used than formerly, and yet the diseases in question are not evidently on the increase; and in England, in many places where oatmeal is only considered fit food for horses, no cases of rachitis or of osteomalacia were observed. Furthermore, the ash of wheat yields more phosphoric acid than that of oats—the former contains 49·81 per cent and the latter only 43·84 per cent of that substance. It is true, however, that the ash of oats contains more lime than the ash of wheat; but then wheat contains quite enough of lime to build up bone-tissue—hence the fact that certain people do not build up sufficient bone-tissue, no matter what their diet may be, is proof that the diseases are due to a tendency in the individuals to waste, and not to assimilate these very phosphates which wheat-flour contains in abundance. This explanation, also, must therefore be dismissed as insufficient.

Another opinion ascribes the deformity to the peculiar method of carrying their babies in vogue among the women of Glasgow. A large shawl or plaid is wrapped over one shoulder and around the waist of the mother, with one turn around the baby, which is additionally supported by sitting on the mother's arm. This is a very convenient way of carrying a baby—almost as convenient as that adopted by some savage tribes, whose papooses are borne in a basket slung over the mother's back. It is only employed when the mother is out on an errand; and, though the child's legs, of course, are somewhat constrained by the shawl, the actual time during which that is the case amounts to

very little in the twenty-four hours, and is not long enough to produce the deformity. Moreover, not many miles away, at Saltcoats, on the Ayrshire coast, all the women carry their babies in precisely the same manner as in Glasgow, and yet not a single case of rachitis or osteomalacia is to be seen there. The people of Saltcoats, however, are Scotch. The same method of carrying babies is quite common over all the south and west of Scotland, yet nowhere else in the country, except in Glasgow, are so many horrible cases of rachitis or of osteomalacia to be seen.

Some persons, observing that many of the Glasgow mothers, whether married or unmarried, are workers in the mills — cotton, woolen, linen, and jute mills—are of the opinion that there is something in their employment that promotes bandy-leggedness. But, so far as I could observe, the children of such women were no more rickety than the children of women in other occupations. The mills in Great Britain are, so far as their hygienic condition is concerned, far better provided for than the mills of any other country in the world; they are looked after by the Government, and regularly visited by a competent and responsible inspector. Mill-workers have, nowadays, an easy, comfortable, and healthful occupation, and really there is nothing in mill-work to deform or injure either the women or their children.

Many lay the blame for the trouble upon the air. Glasgow air does not appear to be different from other air, and is certainly no worse than that of a dozen other manufacturing cities where no unusual bandy-leggedness exists. Consideration of this point may, then, be dismissed at once.

The writer believes that an adequate explanation for the affliction may be found in the habits of the Irish people. It is well known that all over the south and west of Ireland thousands of the peasantry live in mud cabins, which are for the most part several feet below the level of the surrounding soil, many of them destitute of windows, doors, and chimneys, the places of which are supplied by simple holes. The cabins are warmed by a peat-fire in the center of the burrow under the hole in the roof. The fuel is got from the adjacent bog, and its smoke would speedily blear and blind the eyes of any stranger who might venture to go inside. Such holes are continually damp, and are hot-beds (or rather *cold* beds) of rheumatism, rickets, osteomalacia, and various other diseases. There are generally half a dozen or more miserable children, huddled together for mutual warmth in the cold months, along with the parents, in addition to whom there is generally at least one full-grown pig, with perhaps a litter of young ones. The food of the family consists chiefly or entirely of potatoes, and it is seldom indeed, that any of the members see bread or meat, although occasionally a little fish, in the shape of eels from the adjacent "bog-holes," may find its way to their mouths.

According to Marshall ("Human and Comparative Physiology"), "potatoes are a weak food, one pound being only equivalent to about six ounces of bread, or four ounces and a half of lentils; they are not much more nutritious than the succulent vegetables." It follows that, in order to support the body at all, enormous quantities must be eaten. The stomach expands to accommodate the huge bulk of this inefficient food, the body becomes paunchy, and the limbs of children, enfeebled by rachitis, occasioned partly by the miserable food and partly by the unwholesome surroundings, bend under the weight of the trunk, and the deformity already described is the result. The writer remembers distinctly the time when large bands of Irishmen used to visit England and Scotland, during the autumn of each year, to be employed on the harvest-field as shearers or reapers. But, owing to the introduction of machinery, that occupation is gone. The harvest only employs men for a few weeks each year; but the building of iron ships is carried on all through the year: the shearers have become riveters, and have remained in Glasgow. The late Hugh Miller, describing those reapers, wrote thus: "Pot-bellied and bow-legged, and with scarcely a rag to cover them, these wretches walk abroad into the daylight of civilization, the annual apparition of Irish ugliness and Irish want." The vice of constitution, acquired in the miserable cabins of the wilds of Connaught, has become hereditary, and it is the now recognized principle of heredity which accounts for the deformed legs of the children of Glasgow. When the bones are bent at obtuse angles, the deformity is usually treated in the hospitals by fracture, i. e., the bones (both tibiæ and fibulæ) are broken at the angle, and the fracture is treated in the usual manner. This is done, however, after the bones have become hard and have assumed a permanent set.

It may be objected by American observers that the Irish in America exhibit none of these excruciating deformities. But it must be remembered that few but reasonably able-bodied Irish manage to get to America. Few others can get together the means to pay their passage; and any cripples or seriously deformed persons would be liable to be refused passage by the transportation companies, or rejected and sent back as paupers on arrival here. At this point, again, the law of heredity comes into play, for if the parents, and the children which they bring along with them, are not rachitic, the chances are that the children and children's children born in America will not be rachitic either.

SKETCH OF ABÛL-WALID MOHAMMED IBN-AHMED IBN-MOHAMMED IBN-ROSHD (COMMONLY CALLED AVERROËS).

By GEORGE JACKSON FISHER, M. D.

DANTE tells us that when he descended into the infernal regions, on arriving at limbo, which is the first and favored circle of hell, where the good and virtuous are permitted to reside, having been excluded from the bliss of paradise from neglect of baptism, he found "a sapient throng," with Aristotle, "the Master"—

> "Seated amid the philosophic train";

and, when a little more he raised his brow, he "spied"

> ". . . Hippocrates,
> Galenus, Avicen, and him who made
> That commentary vast, Averroës."*

It is of this vast commentator and renowned Saracenic physician that I now propose briefly to write. Averroës flourished, without a doubt, in the twelfth century; there is, however, no inconsiderable amount of uncertainty and discrepancy among authorities concerning the precise time of his birth, some placing it as early as the year 1126, others as late as 1198. The same confusion exists as to the date of his death, ranging it from 1198 to 1225. The dates (1126–1198) are believed to be as nearly accurate as can be determined at this time. By this assumption it appears that Averroës attained the age of seventy-two years. He was of an ancient and noble family, being the son of the high-priest and chief judge of Cordova, the beautiful capital city of Andalusia, in Spain. Cordova was the place of his nativity.

Leo Africanus informs us ("De Vir. Arab.," p. 280) that Averroës commenced the study of philosophy, when he was but a youth, under the celebrated Thophail, or Ibn-Tofail (Abubacer), who is the author of the noted metaphysical tale "Hai Ebn Yochdan." An English translation of this elegant story was published by Professor Ockley, of Cambridge, in London in 1711. It is not unlikely that the extreme admiration which Averroës always entertained for the writings of Aristotle was inspired by the enthusiastic teachings of Ibn-Tofail. His unbounded admiration of Aristotle amounted to a profound reverence, for thus we find Averroës asserting that "the doctrine of Aristotle is the perfection of truth, and his understanding attained the utmost limit of human ability; so that it might be truly said of him that he was created and given to the world by Divine Providence, that we

* "Inferno," Vision, Hell, canto iv.

might see in him how much it is possible for man to know." Averroës devoted a great portion of his life to literary pursuits, but chiefly to his chosen task of expounding the doctrines of his favorite author. A printed edition of his works, in ten large folio volumes, furnishes ample testimony of the extent of his labors, and fully justifies the cognomen of "The Commentator," and of Dante's expression "that commentary vast." He was also styled "the soul of Aristotle."

It has been said that he wrote his medical treatises for the purpose of reconciling the doctrines of Galen with the philosophy of Aristotle; for it is evident that his estimation of the medical philosopher of Pergamus was only second in degree to the almost veneration which he entertained for the philosopher of Alexandria.

It is not within the compass or purpose of this sketch to furnish the reader with even a brief summary of the peculiar characteristics of the metaphysical doctrines which constitute what has been termed Averroism, or to give an account of its wide-spread influence throughout Europe, and particularly during three entire centuries in the universities of Northern Italy. I will merely state that Padua became the seat and center of "Averroist Aristotelianism," and that Petrus de Apono, about the year 1300, became a famous expositor of these doctrines in their relation to medicine, and an equally noted example of heterodoxy in matters of faith; so much so that his effigy was burned in the public market-place by the executioner, at the command of the Inquisitors. Though for ages both Aristotle and Averroës were regarded as the supreme masters of the science of proof, yet their teachings were considered inimical to the requirements of religious faith; their disciples were called derisively "the people of demonstration." Later on, Erasmus and others poured out the vials of their contempt on scholastic barbarism with its "impious and thrice-accursed Averroës."

To return to his personal history. Averroës lived not long after Avenzoar, whom he calls "admirable, glorious, the treasure of all knowledge," and the most supreme in physic from Galen to his own time. Averroës was personally acquainted with the sons of Avenzoar. He was a great student. It is said that, under the most approved teachers of his time, he mastered theology, jurisprudence, mathematics, philosophy, and medicine. He flourished at a time when the Moslem caliphate in Spain had attained its maximum splendor, and such as had only been excelled by the ancient Oriental glories of Arabia and Persia. Cordova was the Bagdad of the Occident. Averroës worshiped in great and magnificent mosques, attended schools and colleges of erudition and renown, consulted libraries vast in extent, rich and rare in quality; walked large hospitals, whose cases supplied ample illustrations of all the mortal ills to which our poor humanity is subject; and, having been introduced by Ibn-Tofail, the philosophic vizier of Jusuf, to that prince, he possessed every requisite qualification and influence to insure success and distinction in life. Averroës,

being master of the Melekitic law, was appointed cadi of Seville in the year 1169, and for a quarter of a century occupied his time in similar offices in Cordova, Seville, and Morocco, belonging at the same time to the court of the reigning monarch Jusuf Almansur, who, it is said, was fond of engaging him in philosophic discussions in relation to the Islam faith.

The profound acquirements which he had made in all departments of learning, and particularly in scholastic philosophy, by which the name of Averroës had become famous, eventually resulted in his almost total ruin. He was accused of heresy, and his teachings were declared to be inimical to Moslem faith.

The charges were signed by a hundred witnesses, who testified that they had listened to heresies uttered from his own lips. The Caliph's fears of the populace, in a matter so vital to their religious belief, overpowered his love for Averroës, and drove him to rigid measures. He confiscated his property, deprived him of honors, offices, and emoluments, and banished him to a place outside the walls of Cordova, there to dwell with the Jews and other outcasts in the suburbs. Africanus goes on to say that the boys used to watch the opportunity of his going up to the city, at the hour of prayers, to pelt him with mud and stones. Such was the force of the fanatical indignation against poor Averroës, that everywhere he was subjected to the jeers and insults of a bigoted populace. All this occurred about the year 1195, at which time a general effort was made to destroy all liberal culture in Andalusia, reserving only such practical branches as would prove most useful to the people, including medicine, surgery, mathematics, and astronomy.

From all these misfortunes, ignominy, and degradation he at length escaped, and betook himself to Fez, whither he was soon pursued, arrested, and committed to prison. The royal council could not agree concerning the issue of his fate. Instant death was demanded by some, while others insisted on permitting him to live, and extorting from him a public recantation of his errors. The final decision was that he should be led out bareheaded, at the hour of prayer, and placed on the upper step at the entrance of the mosque, that every one as he passed in might have an opportunity of showing his holy wrath and indignation by spitting in the heretic's face. It is said that this contemptible treatment was submitted to with stoical indifference. When the service was ended, the judge and officers of the court came forward and listened to a public confession of his alleged heresies. Averroës was then permitted to return to Cordova, where he entered in privacy, and remained in poverty, rags, and wretchedness; scorned, neglected, with none for associates but the most degraded classes of society. Great, indeed, was the fall of Averroës! The limbo of Dante must at last have proved to him a paradise indeed!

This poor philosopher had not yet reached the end of his eventful

life. Owing to the misrule of his successor in the regency of Morocco, the discontented people earnestly petitioned the ruler of the Faithful to restore their former governor, whose mildness and wisdom had secured to them so high a degree of prosperity and so many blessings. After much deliberation Averroës was restored to freedom, reinstated in his positions of honor, where his moral virtues, his amiability, his justice, and his humanity, were exercised to the advantage of his fellow-beings. He secured the love, the applause, the admiration, and gratitude of the people over whom he ruled, and we are told that happiness gilded the evening of his days, his sun sank gently beneath an unclouded horizon, and his memory was a radiant halo, not unlike the roseate twilight that sometimes lingers along the western sky, the charming influence of which can only be felt and contemplated with emotions of grateful delight. And thus it was that Averroës closed his eventful life in the year of grace 1198, being but about a twelvemonth previous to the death of his patron Almansur, with whom the political power of the Moslems terminated, as did the study of the liberal sciences with the death of Averroës.

He was evidently a man of dignity, rectitude, and nobility; a wise and humane judge; a devoted student; a profound scholar; and, though surrounded by the luxuries of a royal court, yet simple, temperate, almost rigidly abstemious in his mode of life.

As a medical writer Averroës was the author of two works which are still extant; one being the "Koullyath," or "Kulliyyat," which is better known as the "Colliget" or "Summary"; the other is a commentary on the medical poem or *cantica* of Avicenna. The "Colliget," which is his principal work, was dedicated to Abdelech, the Miramamolin of Morocco, and contains a digest of the whole science of medicine, being divided into seven books. It contains but little that is original, though we find him speaking of his own experiences. He is said to be the first to state that small-pox occurs in the human constitution but once in a lifetime. His anatomy is copied entirely from Galen. His commentary on the *cantica* of Avicenna was considered to be the best introduction to medicine that had ever appeared.

Some time ago I picked up a curious little duodecimo entitled "Averroeana," being a transcript of several letters from "Averroës, an Arabian philosopher at Corduba, in Spain, to Metrodorus, a young Grecian nobleman, student at Athens," in the years 1149 and 1150. Also "several letters from Pythagoras to the King of India," etc., etc. "The whole containing matters highly philosophical, physiological, Pythagorical, and medicinal. The work having been long concealed, is now put into English for the benefit of mankind, and the rectification of learned mistakes." London, 1695.

P. Grinau tells us, in his prefatory letter, that his friend Petit, who had for many years resided in Andalusia, gave him the book, which he says was written by Averroës's own hand, and that it had

long lain in the library of a certain nobleman in Andalusia. It deals with many curious physiological questions, and furnishes proof that Averroës was a practicing physician. Space will not permit me to make extracts from the work, though, in passing, it may be mentioned that he speaks of his own experiments and experiences; for example, he discourses at length on the value of milk in the treatment of pulmonary consumption.

The library of the Escurial in Spain still contains in manuscript among its treasures the greater part of the writings of Averroës, particularly those on jurisprudence, astronomy, essays on special logical subjects, and his criticisms on Avicenna and Alfarabius. Other manuscripts are preserved in European libraries. The Latin editions of the works of Averroës have been very numerous. The first appeared at Padua in 1472; about fifty were published at Venice, the best known being that by the Juntas in 1552–'53, in ten folio volumes. During the century from 1480 to 1580 no less than one hundred editions were issued. This fact attests the exalted estimation in which his works were held. None were ever printed in Arabic. The "Colliget" was first printed in 1482, at Venice, in folio; also in 1490, 1492, 1497, 1514, 1542, and 1552. The commentary on the "Canticles" of Avicenna were printed in nearly as many editions, and often with the "Colliget."

Should the reader desire to know more of the philosophy and theology of Averroës, he may be gratified by consulting either or both of the following treatises: Renan, "Averrhoès et l'Averrhoisme," Paris, 1852; and Müller, "Philosophie und Theologie von Averrhoës" Munich 1859.

What authority there may have been for the portrait of Averroës by Raphael, now in the Vatican, I am quite unable to state. The writer has a fine old print, on a folio sheet, of this portrait, engraved by P. Fidanza. It is done in bold pen-and-ink-like strokes, being an Arabian head covered with a massive turban, a face of earnest but fierce expression, more suggestive of a Bedouin chief than of a profound philosopher.

The frontispiece in the present number of the "Monthly" is a reduced copy of this rare engraving.

EDITOR'S TABLE.

THE SURVIVAL OF POLITICAL SUPERSTITIONS.

As explained by the law of evolution, progress is the result of slow transformations in the parts of adaptable organisms under changed conditions. Still, influenced by the old ideas that things were once suddenly created and may be quickly changed, we fail to appreciate the slowness of the modifications that take place, and how tenaciously old things survive and live on in their essences, with only sufficient alteration to justify the introduction of new names.

We see this strikingly illustrated in the history of government. There is an enormous overvaluation in the import of their changing forms. It was, of course, a great event when we of this country, a hundred years ago, repudiated formal monarchy, and its aristocratic and hierarchical appendages, and adopted republican government in its place, but the real value and extent of the change have been in many respects much magnified. Fundamental ideas of the old order of things continue in vigorous operation, with but very superficial modification of character.

For thousands of years the conceptions of government and of kingcraft were identical. Nations appeared and disappeared in the march of history; empires rose and fell, systems of religion and systems of philosophy succeeded each other, knowledge augmented and the literary arts were perfected in their different types, and great civilizations unfolded and passed away, and all this while the forms of government continued monarchical, and human society was governed by the superstition that kings represent the gods and are infallible. The overshadowing and persistent superstition was that government was supernaturally organized, and that kings ruled by right divine. We look upon this idea now as a mere curious vestige of an empty illusion of ages of ignorance, but it was an idea of living application and tremendous power. Men religiously believed in it and thoroughly acquiesced in it. It was broadly asserted alike by the occupants of thrones and by the classes authorized to teach the people, and they accepted it as fundamental and sacred political truth. The open avowal of this doctrine comes down to quite modern times. The standard of loyalty exacted by the sovereign was thus laid down by King James, the translator of the Bible: "As it is atheism and blasphemy in a creature to dispute what the *Deity* may do, so it is presumption and sedition in a subject to dispute what a *king* may do in the height of his power; good Christians will be content with God's will revealed in his word, and good subjects will rest in the king's will revealed in his law."

It is not yet two centuries since De Foe could write in England as follows: "It was for many years—and I am witness to it—that the pulpit sounded nothing but absolute submission; obedience without reserve; subjection to princes as God's vicegerents; accountable to none; to be withstood in nothing and by no person. I have heard it publicly preached that, if the king commanded my head, and sent his messengers to fetch it, I was bound to submit, and to stand still while it was cut off."

Now, it is not to be supposed that so deep and long-established a sentiment, by which the lives of generations were regulated, was to be extirpated from human nature, and dismissed to annihilation in any short period of time. Some features of it might fall away

and be repudiated, and it might be thus transformed, but transformation itself implies the living on of the essential thing in modified shape. Nor can we say that that which has been eliminated and has passed away is simply the superstition, while the surviving element is some truth of reason which was disguised under the old expression. Under a less gross and palpable form the superstition itself continues, and for the divine infallibility of the king we have a superstitious belief in the practical infallibility of Congress and the political majority. "The king may do all things by divine right, and we are bound to obey," was the old formula; "the political majority may do all things in its sovereign pleasure, and everybody is bound to obey," is the derived formula of the present time.

The supernatural element in the case is undoubtedly gone, but the blind and unreasoning faith which is the essence of superstition is the survival which is still to be dealt with. What is the ground of the authority of government? In what does its sovereignty consist? Is it supreme and unlimited, or is it subject to restriction? And, if so, what are the principles of limitation? What may government do and what may it not do? What is the fundamental right and wrong of government action to which all legislation is bound to conform on imperative ethical grounds? These are questions that are forced upon the age with a steadily increasing urgency, and the answers to which are of transcendent importance to the future progress of society.

These questions are besides of especial and critical moment in this country, where the whole community is launched upon the turbulent sea of politics, and there is the highest possible need of distinct and trustworthy politico-ethical guidance. That the subject receives little serious attention on the part of our ignorant and self-seeking politicians, occupied with their paltry schemes of partisan rivalry, matters little except to impose graver obligations upon serious-minded people. The degradation of popular government in this country to the basest ends of demagogism, the tendency to rule out all questions of principle as disturbing elements in the great game of partisan success, the surrender of Legislatures to the promotion of sordid class interests, and the universal negelect of the true objects of government, while its illegitimate objects are everywhere vehemently pursued—all this is sufficiently notorious, and it marks out the definite work of our political reformers in the future. The present state of things is not a finality, and there is no justification for despair of salutary political progress. The passage from superstition to reason is slow and unsteady, but it is inevitable. Government is not to be run forever on fallacies and by political quacks. We are in a time of transition, which is always painful and discouraging, but tendencies are at work, and are slowly acquiring strength, which are certain to make headway against the errors and vices of the prevailing political system. It is of course very easy to be oversanguine, and to form delusive expectations of good to be attained, and there is especial danger of this in politics, where it is expected by changing a vote or passing a law to get great results in a short time. But political renovation can come by no such superficial means; we must have a revolution of ideas, resulting in sounder views of the nature, authority, and scope of government; and that this will come in its proper time, and give rise to a new departure in politics, is no more to be doubted than we can doubt the continued activity of the human mind, the further growth of scientific thought, or the many improvements and ameliorations that have been already accomplished.

Meantime, the work to be done is simply to diffuse among the more intelligent classes of the community those

deeper social truths and sounder political principles which have been worked out by patient and powerful intellects who have prized and sought the truth above all other things, trusting implicitly that better knowledge will at length yield the desirable fruits of better practice. This has been the policy of "The Popular Science Monthly." We are interested in politics, but only in that regeneration of politics which will make its pursuit more honorable, its objects more noble, and its influence upon society less corrupting and debasing, and more elevating and beneficent. We have frequently published articles animated by this spirit and purpose; and have been led to the foregoing remarks by a desire to call attention to the instructive and valuable article which opens the present number. We commend this discussion of the important but neglected subject of political ethics to the careful perusal of all who are interested in the solution of the most pressing political problems of the time.

PRESIDENT ELIOT ON LIBERAL EDUCATION.

THE address of the President of Harvard University, entitled "What is a Liberal Education?" delivered in February, before the members of the Johns Hopkins University, and published in full in "The Century" magazine for June, is a contribution to the subject so able, advanced, and independent that it deserves to be carefully read by all who are concerned in higher educational reforms. The article has great and peculiar value, because it has been produced under the pressure of grave responsibility, and presents views which have been subjected to every critical test preparatory to carrying them out in the eminent institution of which the author is the distinguished head. It is easy to talk at random, and indulge in exaggerated statements, but we have here the cautious and measured conclusions of a wise educational policy to be reduced to actual practice. But caution here does not mean timidity. There are a firmness of tone and a boldness of treatment in this paper which show that the author appreciates the urgency of the situation, and has perfect confidence in the strength of his case. This address is therefore to be commended to all the friends of educational improvement as having the force, weight, and seriousness of an authoritative document, and for this reason we are glad to observe its appearance in a magazine of wide circulation and large influence, and we hope it may soon be separately issued and extensively distributed for effective use in the quiet campaign of collegiate reform. It is a fitting sequel and supplement to the Harvard address of Mr. Adams last year, which proved so efficient in arousing public attention to the deficient working of our American colleges, but it is a broader and more philosophical discussion of the defects and requirements of the higher education at the present time, and grapples with the wide question of there organization of the university curriculum, and the necessity of making the so-called liberal education more thoroughly liberal than the traditional system that has come down to us from the past.

President Eliot opens his argument with the remark that the degree of Bachelor of Arts, which is the customary evidence of a liberal education, needs to be defined anew, with an enlargement of its signification; and he shows, first, that, so far from being a settled, permanent, and unchangeable ideal for all time, as the devotees of the classics are so fond of maintaining, it has already undergone change after change with the progress of learning, so that the studies essential to the bachelor's degree, both in their subject-matter and in their disciplinary influence, have been radically different in the centuries that have succeeded after it was instituted. Even mathematics,

which seems to be the very type of unchangeable method, he shows to have undergone nothing less than a revolution, so that that form of it, which Dr. Whewell defended as "a permanent study," has disappeared, and been replaced by another mathematics of a totally different sort. The modern analytical mathematics, "the only mathematics now in common use in the United States," is thus characterized by the Master of Trinity in contrast with the earlier geometry. He says: "We must hold also that the geometrical forms of mathematics must be especially preserved and maintained as essentially requisite for this office (the study by which the reason of man is to be educated); that analytical mathematics can in no way answer this purpose, and, if the attempt be made so to employ it, will not only be worthless, but highly prejudicial to men's minds."

In regard to another unalterable element of the disciplinary curriculum, President Eliot remarks: "It is obvious that the spirit and method in which Latin has been, for the most part, studied during the present century, are very different from the spirit and method in which it was studied in the preceding centuries. During this century it has been taught as a dead language (except, perhaps, in parts of Italy and Hungary), whereas it used to be taught as a living language, the common speech of all scholars, both lay and clerical. Those advocates of classical learning who maintain that a dead language must have more disciplinary virtue than a living one would hardly have been satisfied with the prevailing modes of teaching and learning Latin in any century before our own." Even Greek, so lauded as "an instrument for the perpetual training of the mind of the later generations," has not always been a constituent of the accepted scheme of liberal education. "It took two hundred years for the Greek language and literature gradually to displace, in great part, the scholastic metaphysics, which, with scholastic theology, had been for generations regarded as the main staple of liberal education; and this displacement was accomplished only after the same sort of tedious struggle by which the new knowledges of the eighteenth and nineteenth centuries are now winning their way to academic recognition. The revived classical literature was vigorously and sincerely opposed as frivolous, heterodox, and useless for discipline; just as natural history, chemistry, physics, and modern literatures are now opposed. The conservatives of that day used precisely the same arguments which the conservatives of to-day bring forward, only they were used against classical literature then, while now they are used in its support."

The sticklers for traditional immutability being thus disarmed, by showing that "new learning has repeatedly forced its way in times past to full academic standing, in spite of the opposition of the conservative, and of the keener resistance of established teachers and learned bodies, whose standing is always supposed to be threatened by the rise of new sciences," President Eliot proceeds to point out the imperative necessity of still further important changes that shall bring university and college studies into completer harmony with the present state of knowledge and the demands of modern life. The ground taken is thus broadly stated: "To the list of studies which the sixteenth century called liberal, I would therefore add as studies of equal rank, English, French, German, history, political economy, and natural science, not one of which can be said to have existed in mature form when the definition of liberal education, which is still in force, was laid down. The claims of these studies are taken up separately; it is shown how widely and grossly they are neglected, and their right to coequal recognition

with older studies is argued with great force and entire conclusiveness. As an example of the vigor with which the claims of these several subjects are presented, we quote what President Eliot says about the study of English:

The first subject which, as I conceive, is entitled to recognition as of equal academic value or rank with any subject now most honored, is the English language and literature. When Greek began to revive in Europe, English was just acquiring a literary form; but, when Greek had won its present rank among the liberal arts, Shakespeare had risen, the English language was formed, and English literature was soon to become the greatest of modern literatures. How does it stand now, with its immense array of poets, philosophers, historians, commentators, critics, satirists, dramatists, novelists, and orators? It can not be doubted that English literature is beyond all comparison the amplest, most various, and most splendid literature which the world has seen; and it is enough to say of the English language that it is the language of that literature. Greek literature compares with English as Homer compares with Shakespeare—that is, as infantile with adult civilization. It may further be said of the English language, that it is the native tongue of nations which are preeminent in the world by force of character, enterprise, and wealth, and whose political and social institutions have a higher moral interest and greater promise than any which mankind has hitherto invented. To the original creations of English genius are to be added translations into English of all the masterpieces of other literatures, sacred and profane. It is a very rare scholar who has not learned much more about the Jews, the Greeks, or the Romans through English than through Hebrew, Greek, or Latin.

And now, with all this wonderful treasure within reach of our youth, what is the position of American schools and colleges in regard to teaching English? Has English literature the foremost place in the programmes of schools? By no means; at best only a subordinate place, and in many schools no place at all. Does English take equal rank with Greek or Latin in our colleges? By no means; not in the number and rank of the teachers, nor in the consideration in which the subject is held by faculty and students, nor in the time which may be devoted to it by a candidate for a degree. Until within a few years the American colleges made no demand upon candidates for admission in regard to knowledge of English; and, now that some colleges make a small requirement in English, the chief result of the examinations is to demonstrate the woful ignorance of their own language and literature which prevails among the picked youth of the country. Shall we be told, as usual, that the best way to learn English is to study Latin and Greek? The answer is, that the facts do not corroborate this improbable hypothesis. American youth in large numbers study Latin and Greek, but do not thereby learn English. Moreover, this hypothesis is obviously inapplicable to the literatures. Shall we also be told, as usual, that no linguistic discipline can be got out of the study of the native language? How, then, was the Greek mind trained in language? Shall we be told that knowledge of English literature should be picked up without systematic effort? The answer is, first, that, as a matter of fact, this knowledge is not picked up by American youth; and, secondly, that there never was any good reason to suppose that it would be, the acquisition of a competent knowledge of English literature being not an easy but a laborious undertaking for an average youth—not a matter of entertaining reading, but of serious study. Indeed, there is no subject in which competent guidance and systematic instruction are of greater value.

LITERARY NOTICES.

THE PAST AND PRESENT OF POLITICAL ECONOMY. By RICHARD T. ELY, Ph. D. Baltimore: N. Murray. Pp. 64. Price, 35 cents.

THIS is a contribution to the "Johns Hopkins University Studies in Historical and Political Science," edited by Herbert B. Adams, and constitutes No. III of the second series. The scheme of publication is an important one, but it contains no contribution more valuable than this monograph on the present condition of political economy by Dr. Ely.

There is unquestionably a good deal of confusion of mind among general readers in regard to the present condition of the so-called science of economics. While the subject continues to rank, as it has long ranked, as a branch of science with its accredited text-books, and its status in the curriculum of higher collegiate study, on the other hand many articles have latterly ap-

peared in the graver reviews questioning the soundness of its theories, the validity of its principles, and the trustworthiness of its guidance. A reaction has set in against the old forms of economical doctrine, which long passed current, and there are many who will be glad to understand the meaning of it. Is there no such thing as a science of political economy in the established sense of the term science? Are there no ascertainable laws in the economical division of social phenomena? Is political economy a legitimate but still an imperfect science; and are the controversies that have arisen over many of its doctrines but the necessary stages of its further and higher development?

In this perplexity of inquiry, Dr. Ely comes to give us an account of the situation, to trace the history of the subject, to show the changes that it has undergone, and report upon its present attitude in the world of thought. We do not understand him as denying the possibility or even the present existence of such a science, but he assumes that diversion from the old views has proceeded so far, and become so distinctive, as to give rise to a new school, which aims to rival and replace the older expositions of the subject. He is an adherent of the new school, and of course, so far as that implies, a disbeliever in the old school, and, at the same time that he informs us, with undoubted fairness, of the features of contrast between them, he is also a strenuous advocate of the one and an adversary of the other.

The nomenclature of these parties who represent different views of political economy has become quite copious, and a reference to it will throw some light on the distinctive doctrines of the opposing partisans. The political economy which may be said to have originated with Adam Smith, and which was subsequently further developed by Malthus, Ricardo, Senior, and James and John Mill, is known as "the old school," and, as it originated in England, "the English school." With reference to the authority and wide acceptance of its teachings, it is referred to also as "the orthodox school" and "the classical school"; and, as some of the most vigorous of its propagandists had their headquarters at Manchester, it has been called "the Manchester school," while, with reference to its predominant method of inquiry, it has also been termed "the deductive school."

The rival system of political economy, which now claims attention as a "new school," is declared by Dr. Ely to have originated in Germany about 1850, being represented by three young German professors, Hildebrand, Knies, and Roscher; it is therefore known as "the German school." Protesting against the deductive character of the English political economy, and asserting induction to be the proper basis of economical method, it is known as "the inductive school"; while to bring the subject into rank with politics, jurisprudence, and theology, which are pursued by the historical method, the Germans designate it by perhaps its most characteristic title, "the historical school." It is claimed also that the new method is "statistical," "experimental," and even "physiological"—"to call attention to the fact that it does for the social body what physiology does for our animal bodies."

Dr. Ely devotes the first forty pages of his monograph to the older political economy, dividing his statement into several sections. Section I, "Introductory," offers some general remarks on the growing evidence of the unsatisfactoriness of the political economy of Adam Smith, and his English followers. Section II, "The Old School," pursues the same line of thought, with some critical examination of the leading doctrines that have characterized the English political economy. In Section III, "The Attractions of Economic Orthodoxy," Dr. Ely points out how, from the simplicity of the system, it was fitted to take hold of men's minds while they knew nothing of the real complexities and formidable difficulties of the subject. Because of its narrowness and deductive character, there came also to be great faith in the fundamental propositions of the science which were regarded as permanent truths; while the system was commended to the governing powers in state and society because things were to be left to themselves, and "no exertion, no sacrifice, was required on their part to alleviate the sufferings of the lower classes." In Section IV Dr. Ely discusses the "Merits

of the Old School," which he recognizes were great, independently of the correctness of its doctrines. It did vast service as the pioneer in this field of research, and on this point we quote Dr. Ely's words: "Further, the present political economy in all parts of the world grew out of the classical political economy, and the former can not be comprehended until the latter has been mastered. It was, indeed, efforts to master, extend, and perfect the older school, as well as other causes, like later developments of industrial life, which gradually led to the most recent economic investigation. Nor does any one now doubt the continued and all-pervading—even if not all-controlling—influence of these motive powers which furnish Ricardo, Mill, and Senior, with their major premises; but this fact was not understood before the coryphei of the older political economy elucidated it, and they deserve great credit for what may be fairly termed their discoveries. It was, for example, a service of no mean order to point out all the ramifications of self-interest in economic life, to set in order the phenomena explained by this principle, and to show how it prompts men to the most diverse deeds, which, undertaken without a view to the welfare of others, nevertheless redound to the common good. And it must be confessed that no single principles have been discovered by the German school, which throw such a flood of light on the multifarious phenomena of economic life as do, for example, the Ricardian theory of rent and the Malthusian doctrine of population."

Having made these concessions, Dr. Ely proceeds elaborately in Section V to discuss "The Decline and Fall of the Old School." He objects, first, "that the whole spirit of its practical activity was negative." He attacks the doctrine of *laissez faire*, which he alleges grew out of that negative system, and has turned out to be a total failure. "It never held at any time in any country, and no maxim ever made a more complete *fiasco*, when the attempt was seriously made to apply it in the state." His chief illustrations of the break-down of this doctrine are education and the English factory system. He next arraigns "another favorite notion of the older economists, and one which leads to great hardship in real life, that taxes are shifted so as to be divided fairly between different employments in which capital is engaged." He then condemns "the supposition that self-interest is the chief force of economic life," which he maintains to be the leading premise of the English school. The doctrine of "equality of wages" is attacked as an error of the old economists, as is also the idea "of the natural laws of political economy," and the principle of "supply and demand."

We can not give the reasonings by which the older political economy is impeached in these several particulars, but their enumeration will suffice to inform the reader somewhat of the nature and extent of the indictment against the old system by which it is to be discredited and put aside to make place for another system.

In Section VI the new school is taken up and its various claims presented. Chief among these are that facts and statistics are to be more studied, that there is to be greater caution in theorizing, and especially in the use of deduction; and, above all, that the subject is to be dealt with historically. It seems to be denied that there are any principles of political economy to be taken as fundamental or universal, or as fitted to form the body of a science to be generally accepted like other sciences. The subject is said to involve changed conditions and constantly changing policy. "It is found that the political economy of to-day is not the political economy of yesterday, while the political economy of Germany is not identical with that of England or America. It is on this account that knowledge of history is absolutely essential to the political economist."

Now, while Dr. Ely's statements of the general case are most interesting and instructive, we can hardly acquiesce in the validity of his argument. Much of his criticism of the older political economy may be taken as well-based and wholesome, while his argument is overdone. We may freely concede that the earlier expositions of political economy were imperfect, and that much of its subsequent literature is open to objection. But science is self-corrective in time, and the labor of generations is necessary for the development of its principles, especially if they are of a complex

kind, and dependent upon the advance of other sciences. But the foundations of the old political economy were well laid; the method was broad, valid, and as productive of important results as research in any other field. The correctness of the procedures has been attested by the discoveries of economic laws, worked out, if not into their final forms, at least into such clearness and certainty as to give them value for practical guidance. Granting that there is much need for revision, amendment, enlargement, what is this but the common condition of all progressive knowledge? To speak of the "decline and fall" of the English school of political economy savors of exaggeration, and seems no more proper than to speak of the decline and fall of any other branch of science when its errors are discovered, and it passes to a new stage of its development.

Dr. Ely, as we have seen, charges that the whole spirit of the old school is negative. "It was powerful to tear down, but it did not even make an attempt to build up." Yet in the department of science what can we mean by "building up" if it be not the organization and analysis of facts, the derivation of principles, and the establishment of a connected body of truths as accurate and verifiable as the nature of the phenomena and the condition of knowledge will admit. Is not this in the highest sense constructive work, and, making allowance for the necessary imperfections of the earlier stages of inquiry, it can not be intelligently denied that the English school of economists have established a body of positive truths which can never be subverted, although they may be much further unfolded. We think, indeed, that Dr. Ely's accusation against the English school may be turned with far greater propriety against the German school, which has made no discoveries, constructed no system, worked out no generalizations, and whose main stock in trade appears to consist in its attempts to demolish what the English economists have built up.

We gather from Dr. Ely's argument that a very confusing and also a most mischievous error pervades the teachings of the new school—it does not discriminate between science and art, between economical principles and laws and the art of practical politics. The investigation of phenomena, the establishment of their relations, and the derivation of principles, is a sufficiently large subject to occupy distinctive attention, and science proper ceases when this important work is done. The results gained will be valuable in application, but this is a separate field of effort. Law-making may be helped by science, but to rank it as itself a part of economic science confuses important distinctions. That the German school should favor paternalism in government, and legislative interference with the business life of the people, should magnify the state, belittle individualism, and question the doctrine of natural human rights, is what we are prepared to expect, but when all this is put forward as political economy, and a warrant for the installation of a "new school" to replace a fallen system, the case seems somewhat strained. It is not so easy to take leave of the older idea of legitimate science in this field of thought. And yet the tendency of government to encroach upon the liberty of citizens, and regulate the private affairs of industry and business, although as old as political tyranny, is now coolly put forth as the discovery of a great master of political economy. Dr. Ely says that "Adolph Wagner, the Coryphæus of German economists," has discovered "the law of increasing functions of government"—"has shown how government has taken upon itself function after function, and how the operations of government trench more and more upon the domain of private industry." If the reader will here refer to what is said upon page 302 of this "Monthly," he will get further light upon the new school claim of what it considers a discovery in the progress of political economy.

Dr. Ely objects to the English school, not only that it is deficient in facts and data, indulges too much in theory and neglects history, but also that it is narrow and ignores the wide range of social phenomena with which it is connected; and he refers to Professor Ingham's address, in which it is maintained that political economy must in future be considered from the point of view of social science, or as a branch of the more comprehensive subject of sociology. But, granting that the old system is more

or less open to these objections, do they really stand against the English school of to-day, and has the German school met them in any adequate or systematic way? History is, of course, important; but scholars may dig in history to the end of time to no purpose if they can not reduce their results to organized knowledge. We have the living facts all before us and all around us, open to immediate observation, to be directly studied in their actual relations, and, until the positive and palpable realities of experience are first mastered and reduced to valid method, it is useless to go back into distant ages to study these same phenomena in the vague representations of a history written in utter ignorance of the bare fact of the existence of such a subject as political economy. As well turn the anatomist away from his actual dissections to get help from history by the study of old Arabian treatises, or cutting up Egyptian mummies. History is important; but it is of very subordinate importance, and must be preceded by the scientific investigation of actual facts and laws wherever these are accessible to study. German erudition may add to the rubbish-heaps of chaotic lore regarding the economic life of ancient peoples; but the question remains how German scholars are grappling with the problems of present economic experience. We fail to find evidence that they are making much headway in this direction. Can it be that they have fled to history, "in order to ally themselves with the great reformers in politics, in jurisprudence, and in theology," because of incompetence to deal with this vast subject as it stands in our modern civilization by the strictly scientific method? Whatever view we may take of the extent of the law of evolution, it is at any rate the key of human progress and of social history. Has the historical school recognized it? On the contrary, we must look to England for the thinkers who have made this vast step in the advance of historical method. The monumental work, which complies with all Dr. Ely's requirements, which consists wholly of systematized data and abstains entirely from theory, which considers economical facts in connection with all the other elements of society, which classifies the comprehensive results of investigation with the simple view of drawing scientific conclusions, and which is, moreover, grounded upon the principle of historical development, is an English enterprise—a system of descriptive sociology representing the elements of society in seventy-two communities, past and present, civilized and uncivilized, and treating of civilizations extinct, decayed, and still flourishing. But this valuable contribution to comparative sociology, though prepared with immense labor from his own point of view, and making an epoch in the progress of social science, is not even referred to in Dr. Ely's monograph.

PRACTICAL ESSAYS. By ALEXANDER BAIN, LL. D. New York: D. Appleton & Co. Pp. 338. Price, $1.50.

THOSE who are familiar with the intellectual individuality of Professor Bain and the range of his studies will be prepared to form some idea of the scope and character of this volume of essays, which is in great part a reprint of articles first contributed to reviews. But the title of the volume indicates a characteristic which might not readily be inferred from the quality of Professor Bain's previous works, many of which are scientific and speculative, while the papers which make up this book are of an eminently practical kind. There is much novelty and originality in many of the suggestions made, but the topics selected, and their mode of treatment, will be found useful and helpful to a large number of readers. The first two essays, on "Common Errors of the Mind," are especially of this practical character, and derive interest from the thorough psychological preparation of the writer. The next two essays have an educational bearing; the one on "Competitive Examinations," and the other on the "Classical Controversy." The fifth article is of particular practical interest to students as delineating the mode of treating philosophical questions in debating societies. Dr. Bain considers "The University Ideal" in his sixth article; and the seventh, which is perhaps the most interesting of all, is a chapter omitted from the author's "Science of Education," and is mainly devoted to the methods of self-education by means of books. This essay abounds in instructive suggestions. The eighth article is on "Sectarian Creeds and Subscription to Articles."

The subject is English, and is handled without reservation. The concluding paper of the volume is devoted to the procedure of deliberative bodies, and what may be called the economics of business in such associations; and in this country of multitudinous Legislatures, and where the complaint of non-accomplishment of deliberative work is so general, the hints here given will be found important.

JAMES AND LUCRETIA MOTT: LIFE AND LETTERS. Edited by their Granddaughter, ANNA DAVIS HALLOWELL. With Portraits. Boston: Houghton, Mifflin & Co. Pp. 556. Price, $2.

ASIDE from the charming interest of this volume as a biographical study, it will be found instructive as a record of social experiences during the last half-century that will be increasingly appreciated in the future. It might properly be called "The Life and Times of Lucretia Mott," because it deals fully with her public influence so as to become a valuable chapter in the history of a peculiar religious denomination, which is closely connected with the great anti-slavery reform that was full of such eventful issues to the country.

The history of the Society of Friends, when it comes to be philosophically written, will be full of instructive interest. That the denomination is declining, is very well known; but it has been a power in the religious and social life of the community, and has unquestionably exerted a liberalizing influence upon the stringent dogmatism of the more orthodox denominations. Mystical, devout, narrow in many things, rejecting religious forms, and yet tenaciously clinging to religious form, the Society of Friends has still been more protestant than the Protestants, and it was in advance of most other sects in working free from the iron dogmas of the old theology. The split that occurred in the society in this country about 1828, in which a large division of the membership organized into an independent society under the leadership of Elias Hicks, was but the result of a growing liberality in the bosom of the denomination. That division, moreover, precipitated the question as to how far it was justifiable for Friends to enter into co-operation with the outside world for philanthropic objects. The society had always been deeply pervaded by the anti-slavery feeling, and had entered its formal protests against the system of African oppression in a much more emphatic way than other religious denominations. There was, therefore, a strong sentiment within the society that drew it into sympathy with the anti-slavery movement which began to take definite and organized shape in the North about 1830. But, notwithstanding the traditional impulses and vigorous tendency of the body to join in the general movement, there grew up an active policy of resistance against new alliances, and a determination to hold the denomination within its old sectarian limits of exclusiveness, under which it preferred to bear its testimonies in its own way. It was in this crisis of the denominational affairs that Lucretia Mott came forward upon the scene, and bore that conspicuous and influential part in bringing the Society of Friends into active participation in the anti-slavery struggle which has made her reputation, and for which she will be remembered in the future.

To all interested in these reminiscences the present volume is peculiarly attractive. Its chief subject must be deemed fortunate in her biographer; for, while the book is a loving tribute to personal excellences, and a vivid and charming delineation of character, it has been written with a clear appreciation of the importance of faithfully representing the circumstances and conditions in which Lucretia Mott accomplished her public work. A large portion of the volume consists of letters which have an historic interest as throwing light upon questions, motives, tendencies, and states of mind of individuals, and of masses, in the stirring and exciting times of the early anti-slavery conflict. Lucretia Mott was first of all, and in her whole nature, a reformer, but she was also from the beginning to the end a Quaker, and that she was a good deal of a politician, or at all events of a tactician, is shown by the shrewd and skillful course by which she succeeded in maintaining her position in the society in a time of revolution, and when there was a strong disposition to disown her, as many other prominent abolitionists were disowned because of their affiliations with non-religious societies. Her liberality of thought in religious matters was

an early trait, and is marked throughout her career. She was sympathetic with advanced ideas, and, although neither philosophic nor hardly original in her bent of mind, she had an intuitive sympathy with the pioneers of liberal inquiry, and always spoke of their work with cordial and hearty appreciation. We congratulate the author of the book on the admirable performance of her agreeable task.

PROPERTY AND PROGRESS, or a Brief Inquiry into Contemporary Social Agitation in England. By W. H. MALLOCK. New York: G. P. Putnam's Sons. Pp. 248. Price, $1.

WHATEVER we may think of Mr. Mallock as a philosopher aiming to get at the valuation of life, or as a constructor of social hypotheses, we must grant that at any rate he is a brilliant critic and an effective controversialist. In this volume he overhauls the peculiar socialistic doctrines of Mr. Henry George and Mr. H. M. Hyndman, exposing their fallacies and characterizing their influence with much acuteness of reasoning and equal bluntness of speech. Those interested in these subjects will find the book more than readable. It consists of articles first contributed to the "Quarterly Review," and reprinted without substantial alteration. The writer's aim in the discussion is thus stated: "One of the principal features by which Continental politics have been, during modern times, distinguished from those of England, has, during the last few years, developed itself in England also. I refer to the attempts being now made by extreme radicals on the one hand, and avowed socialists on the other, to identify politics in the minds of the poorer classes with some wholesale seizure, in their behalf, on the property, or on part of the property of the richer; to represent the accomplishment of such a seizure as the main task incumbent on a really popular government, and to madden the people with a conviction that, until the seizure is made, they will be suffering a chronic wrong.

"When we consider the squalor and misery that exist in the heart of our civilization, it is not surprising that language of this kind should sound to many like a new social gospel. The aim of the present volume is to examine, accurately and calmly, into the exact amount of truth underlying this appeal to the sympathies, and to enable the reader to judge whether our contemporary social agitators are men of science, revealing to us new social possibilities, or merely quacks beguiling us with new delusions—whether, in other words, they are the best friends of the people, or whether they are practically their worst and their most insidious enemies."

THE STORY OF THE COUP D'ÉTAT. By M. DE MAUPAS. Translated by ALBERT D. VANDAM. New York: D. Appleton & Co. Pp. 487. Price, $1.75.

THE history of the *coup d'état*, the great crime by which Louis Napoleon converted France from a republic into an empire, will ever be of memorable interest, from the character and consequences of the event; but the main interest of the present volume is derived from the fact that it is written by one who was not only himself in the affair, but one of its master-spirits. M. de Maupas was chief of the police in Paris, and as such had control of the operations by which the usurpation of Louis Napoleon was carried out. It may be that there is not much in the volume in the way of revelation, or that was not more or less known before, but it is an important contribution to the historic literature of that period, from its detailed, circumstantial, and systematic account of the transaction.

THE ELLIPTICON; AN EXPOSITION OF THE EARTH'S ASTRONOMY AND THE EQUATION OF TIME. By J. L. NAISH, B. A. Two-page Chart. New York: J. L. Naish, 43 East Twelfth Street.

THIS chart is an attempt, by means of graphic diagrams and an explanatory text, to make clear the difficult astronomical problem of the equation of time. It contains on one side six representations of the terrestrial and celestial sphere, intended to illustrate the relations of the ecliptic and the equator, motion in the ecliptic and in the equator, and mean and apparent time; and on the other side a section-view of the celestial sphere as regarded from the north pole of the ecliptic—the ellipticon—on which are given the position of the sun, the equation of time, and other elements of the problem, for each day of the year.

HISTORY OF THE LITERATURE OF THE SCANDINAVIAN NORTH. By FREDERIK W. HORN, Ph. D. Revised by the author, and translated by RASMUS B. ANDERSON. Chicago: S. C. Griggs & Co. Pp. 500. Price, $3.50.

THE inhabitants of Norway, Sweden, Denmark, and Iceland once spoke a common language, and were closely alike in manners and customs. Hence the remnants of their early compositions which have been preserved in writing are treated in this work as forming a single literature. After giving an account of the ancient collections of poems known as the Elder and Younger Edda, the author goes on to trace the development of the Skaldic poetry, and follows this with an account of the Sagas. As the present language of Iceland has varied less from the original tongue than either the Swedish or the Dano-Norwegian, an account of the modern Icelandic literature naturally follows the chapter on the Old Norse. In the second division of the book, the literatures of Denmark and Norway are taken up together; the first two chapters trace their progress through the "Middle Age" and the "Age of the Reformation." Then follows "The Period of Learning" (1560–1700), characterized by the supremacy of the Latin language and of theological learning. The next fifty years are described as the time of Holberg. Of this powerful writer of comedies the author says: "He not only cleared the ground, and winnowed away a vast amount of rubbish which had hindered the development of intellectual life, but, what was of chief importance, the barriers were thrown down which had for centuries separated the people from the learned class, and which the Reformation, with its fresh breath sweeping through the northern lands, had not been able to remove." The period from 1750 to 1800 is called "The Age of Enlightenment," during which appeared Johannes Ewald, whom the author rates as "one of the greatest lyric poets of the North—perhaps even the very greatest." With the present century begins the period of modern Danish literature, whose foremost representative is Oehlenschläger. During this time have appeared also the well-known names, H. C. Andersen, Paluden-Müller, Oersted, Steenstrup, Rask, and Madvig. The literature of Norway since 1814, when that country obtained its independence, is treated in a separate chapter. In Swedish literary history, after the period of the Reformation, came "The Stjernhjelm Period" (1640–1740), which was the time of "Sweden's golden age." Then follow the "Dalin Age" and the "Gustavian Period," bringing the history to 1800. Other Swedish writers of the present century to whom prominence is given are Almquist, Fredrika Bremer, Rydberg, Von Braun, and Runeberg. There is appended to the volume a comprehensive catalogue by Thorwald Solberg, of the Library of Congress, of important books and magazine articles relating to the Scandinavian countries, their language and mythology, which have appeared in English.

LIFE AND TIMES OF THE RIGHT HON. JOHN BRIGHT. By WILLIAM ROBERTSON, author of "Old and New Rochdale." London, Paris, and New York: Cassell & Co., Limited. Pp. 588. Price, $2.50.

"ONE anecdote of a man is worth a volume of biography," said Channing; and, in conformity to this dictum, the author's plan has been, "besides resetting gems that adorn Mr. Bright's speeches, to weave into the biography interesting information which is not generally known, and which has been collected especially and solely for this work." The extracts from speeches are numerous, embracing Mr. Bright's utterances on a wide range of subjects, from the temperance question, on which he made his first public speech at the age of nineteen, to the land-troubles in Ireland. The book is a very readable account of the career of one of the most highly esteemed of living statesmen.

THE EVIDENCE FOR EVOLUTION IN THE HISTORY OF THE EXTINCT MAMMALIA. By E. D. COPE, of Philadelphia, Pa. Printed at the Salem Press, Salem, Mass. Pp. 19.

THIS essay comprises the substance of a paper read before the American Association at its Minneapolis meeting last year. It is a presentment of the subject, made by an author whose extensive acquaintance with the extinct mammalia of our continent —the remains of which he has largely contributed in bringing to light—makes him peculiarly competent to deal with it.

LOCAL GOVERNMENT AND FREE SCHOOLS IN SOUTH CAROLINA. By B. JAMES RAMAGE. Baltimore: Johns Hopkins University. Pp. 40. Price, 40 cents.

THIS is the twelfth of the valuable series of "Johns Hopkins University Studies in Historical and Political Science." It traces the development of the peculiar political system by which South Carolina was distinguished before the war from the aristocratic plan of the original settlement in the province, under the influence of Locke's "Fundamental Constitutions," as a county palatine, with its lords proprietors, palatines, and its nobility of landgraves and cassiques. This scheme was short-lived, and gave way to the parish organizations in the coast country. Afterward the upper country was settled, and evolved a county system of local government. Then the county system and the parish system clashed, and the district system, which lasted till after the war, was formed for the whole State. This, in turn, was remodeled, and the name "district" was changed to "county" after the war. The second part of the pamphlet is devoted to the history of "Free Schools in South Carolina," with the design of showing that the State had earlier and more liberal provisions for free education than it has been supposed to have had.

VOICE, SONG, AND SPEECH: A Practical Guide for Singers and Speakers. By LENNOX BROWNE, F. R. C. S. Ed., author of "The Throat and its Diseases," "Medical Hints on the Singing Voice," etc., and EMIL BEHNKE, author of "The Mechanism of the Human Voice," etc. New York: G. P. Putnam's Sons. Pp. 322. Price, $4.50.

THIS work deals mainly with the physiology and hygiene and the acoustics of the voice. The need of a scientific basis for the production, cultivation, and preservation of the voice is insisted on in the first chapter, and strikingly illustrated by directions given to pupils by some authorities. For instance, "To focus the sound; to direct the voice toward the roof of the mouth —against the hard palate—against the upper front teeth—into the head—to the bottom of the chest; to lean the tone against the eyes! to sing all over the face!" The laws of sound bearing on the voice are next stated, after which the anatomy of the vocal organ is described at length, and the respiratory action is explained. Under vocal hygiene, the proper mode of breathing is described, and cases are given which show the loss of vocal power resulting from a waist deformed by constriction. A chapter on the laryngoscope, its use, and teachings, follows. Voice-culture is taken up under the headings "Breathing, Attack, Resonance, Flexibility, and Registers." Directions are given for the "Daily Life of a Voice-User," and there are chapters on "Ailments of the Voice-User" and "Defects of Speech." As this work is the joint production of a vocal surgeon and a voice-trainer, who have been in the habit of collaborating in the treatment of patients and pupils, the authors believe that it possesses a completeness which is seldom attained by a specialist in a single department. The volume is illustrated with photographs of the larynx and the soft palate in various positions, and with numerous woodcuts.

THE GÜEGÜENCE: a Comedy Ballet in the Nahuatl-Spanish Dialect of Nicaragua. Edited by DANIEL G. BRINTON, A. M., M. D. Philadelphia: D. G. Brinton. Pp. lii-94. Price, $2.50.

THIS is the fourth volume of Dr. Brinton's "Library of Aboriginal American Literature." The play which is presented in it is the only specimen of the native American comedy known to the editor. It is of comparatively recent origin, and is composed in a mixed dialect, a jargon of low Spanish and corrupt Aztec, or Nahuatl. It bears marks of its native composition in both its history and spirit, and illustrates the sort of humor popular with the tribes from whom it has been obtained, so that it is of considerable anthropological value. The piece is one of several kinds of *bailes* or dramatic dances common among the Nahuas or Aztecs of Nicaragua, and pictures the devices which an elder of the tribe employed to escape the censure of the *alguacil* before whom he was brought up for discipline. Its chief literary character is a coarse, rollicking humor, and it contains some music of no little merit. The most valuable part of the book is the introduction, in which Dr. Brinton precedes the history and a minute analysis and criticism of the play

with accounts of the Nahuas and Mangues of Nicaragua, their "bailes" or dramatic dances, and their musical instruments and music.

THE CINCHONA-BARKS. By FRIEDRICH A. FLUCKIGER, Ph. D., Professor in the University of Strasburg, and author of "Pharmaceutical Chemistry." Translated by FREDERICK B. POWER, Ph. D., Professor of Pharmacy and Materia Medica in the University of Wisconsin. Philadelphia: P. Blakiston, Son & Co. Pp. 101. Price, $1.50.

THIS treatise comprises a statement of the botanical position of the cinchonæ, with descriptions of the most important species, an account of cinchona-culture and the collection of the barks, the varieties of bark, their appearance and structure, together with some statistics of the industry. In the section on the quantitative estimation of the alkaloids, the translation has a somewhat more detailed description of the author's method of assay than was given in the original, and a more explicit account of the process of Squibb, as recently improved. The method of De Vrij has been added, and also his process for the determination of crystallizable quinine in the mixed alkaloids. A history of the cinchona-barks follows, and a list of about forty titles in the recent literature of the subject completes the volume. It is illustrated with eight lithographic plates and one woodcut.

SCIENTIFIC PAPERS OF THE VASSAR BROTHERS' INSTITUTE, AND TRANSACTIONS OF ITS SCIENTIFIC SECTION, 1881–1883. Le Roy C. Cooley, Ph. D., Chairman. Poughkeepsie, N. Y. Pp. 118.

THE Vassar Brothers' Institute was organized in the spring of 1881, and the scientific section in June of the same year. The present volume of its Transactions embraces the proceedings of thirteen stated meetings up to April 18, 1883, with the chairman's report of the work of the section, and nine papers on subjects of interest in various fields of science. The objects of the Institute are to pursue such scientific researches as may come within the opportunities of its members, and to found a suitable museum. Its proceedings bear evidences of life and vigor.

THE GOSPEL ACCORDING TO SAINT MATTHEW. Revised Version. Fonetic edishun. St. Louis: publisht bai T. R. Vickroy. Pp. 88. Price, 50 cents.

THIS phonetic edition of Matthew is commended by its editor to those who have occasion to teach adults to read. The value for this purpose of print in which the use of letters is logical and uniform is attested by the superior readiness with which the reading of English has been taught in "Freedmen's schools," and is being taught to-day in certain schools of France from books in phonetic spelling. Dr. Vickroy explains in an appendix the values of the thirteen new letters which he uses.

THE MEDICAL DIRECTORY OF PHILADELPHIA FOR 1884. Edited by SAMUEL B. HOPPIN, M. D. Philadelphia: P. Blakiston, Son & Co. Pp. 205. Price, $1.50.

THIS volume contains lists, arranged both alphabetically and by streets, of the physicians, homœopathic physicians, dentists, and druggists, of Philadelphia, with information in regard to the hospitals and other charitable institutions, medical colleges, ambulance service, coroner, and quarantine. It gives also the State regulations in regard to dissection, the registration of medical practitioners, and the registration of births, marriages, and deaths.

BULLETIN OF THE PHILOSOPHICAL SOCIETY OF WASHINGTON. G. K. GILBERT, Secretary. Washington: Judd & Detweiler. Vol. VI. 1883. Pp. 168.

THE "Bulletin" is published by the cooperation of the Smithsonian Institution. The present volume contains the minutes of the society for 1883, and the minutes of the mathematical section from its organization to the close of the year. A number of valuable papers are contained in the volume, among which we mention especially only the annual address of the President, J. W. Powell, on "The Three Methods of Evolution."

D. APPLETON & Co. will publish shortly a volume by the author of "Conflict in Nature and Life," entitled "Reforms, their Difficulties and Possibilities." The penetrating and judicial spirit exhibited in the

author's first work will lead many readers to look to the promised volume with no little expectation.

"THE Outlines of Psychology, with Special Reference to the Theory of Education," by James Sully, now in the press of D. Appleton & Co., is the kind of book that has been long wanted by all who are engaged in the business of teaching and desire to master its principles. In the first place, it is an elaborate treatise on the human mind, of independent merit as representing the latest and best work of all schools of psychological inquiry. But of equal importance, and what will be prized as a new and most desirable feature of a work on mental science, is the educational applications that are made throughout in separate text and type, so that, with the explication of mental phenomena, there comes at once the application to the art of education.

ONE of the most fascinating popular scientific books ever written is Dr. Charles C. Abbott's "Rambles about Home," soon to be issued by D. Appleton & Co. Readers of the early volumes of "The Popular Science Monthly" know how interesting Dr. Abbott's sketches are, and this book will surely impel many to spend their first leisure hours in the country in watching the animal life about them.

PROFESSOR JOHN TROWBRIDGE, of Harvard University, has written a text-book for schools, which D. Appleton & Co. have in preparation. It is entitled "The New Physics," and admirably carries out the principles of the new education, in requiring the pupil to become familiar with the properties of matter and the phenomena of force by performing experiments for himself.

A NEW series of science text-books, each of which is the work of an able specialist, is being brought out by D. Appleton & Co. The "Physiology," by Roger S. Tracy, M. D., Sanitary Inspector of the New York City Health Department, and the "Chemistry," by Professor F. W. Clarke, Chemist of the U. S. Geological Survey, are now ready. Before September 1st will be issued the "Zoology," by C. F. Holder, and J. B. Holder, M. D., Curator of Zoölogy of the American Museum of Natural History, New York; and the "Geology," a new elementary book, by Professor Joseph Le Conte, of the University of California. Other volumes are to follow soon.

PUBLICATIONS RECEIVED.

Proceedings, etc., of the Chautauqua Society of History and Natural Science. William W. Henderson, Secretary. Jamestown, N. Y. Pp. 11.

The Glacial Period in the Chautauqua Lake Region. By Hon. Obed Edson. Jamestown, N. Y.: Chautauqua Society of History and Natural Science. Pp. 13.

Massachusetts State Agricultural Experiment Station. Bulletins No. 7, 8, and 9. Insects injurious to the Apple; Fodder and Fodder Analysis; Insects injurious to Farm and Garden Crops. Pp. 12 each.

Exhibition of Education at the World's Industrial and Cotton Centennial Exposition. Preliminary Circular. Washington: Government Printing-Office. Pp. 11.

Transactions of the New York Academy of Sciences. Index to Vol. II. Albert R. Leeds, Corresponding Secretary, Hoboken, N. J. Pp. 13.

Dictionary of the Action of Heat upon Certain Metallic Salts. J. W. Baird and Professor A. B. Prescott. New York: Bermingham & Co. Pp. 68.

Reports of Division of Entomology, U. S. Department of Agriculture. Washington: Government Printing-Office. Pp. 102.

Samuel Adams, the Man of the Town-Meeting. By James K. Hosmer. Baltimore: N. Murray. Pp. 60. Price, 35 cents.

Physiographic Conditions of Minnesota Agriculture. By Professor C. W. Hall. Minneapolis, Minn. Pp. 15.

Zoölogical Society, Philadelphia. Twelfth Annual Reports. Pp 25, with Plates.

The Bible an Exact Science. By Philip T. West. Topeka, Kansas: George W. Crane & Co. Pp. 56.

Alabama Weather Service, April, 1884. By R. H. Mills, Jr., Director, Auburn. Pp. 6, with Charts.

The Exhalation of Ozone by Flowering Plants. By J. M. Anders, M. D., Ph. D. Pp. 14.

Remarks on the Bag-Worm, pp. 83; Notes on North American Psyllidæ, pp. 12; Canker-Worms, pp. 32; The Army-Worm, pp. 63. By C. V. Riley, Ph. D., Washington.

Principal Characters of American Jurassic Dinosaurs; Parts VII and VIII. Pp. 8 and 12, with Plates. Principal Characters of American Cretaceous Pterodactyls; Part I. Pp. 4, with Plate. A New Order of Extinct Jurassic Reptiles. P. 1. By Professor O. C. Marsh, Yale College, New Haven, Conn.

A New Theology. By the Rev. Philip S. Moxom. Pp. 20.

On the Classification of the Sciences. By H. M. Stanley. London. Pp. 10.

Wages and Trade in Manufacturing Industries in America and in Europe. By J. Schoenhof. New York: G. P. Putnam's Sons. Pp. 25. 15 cents.

Report of Bureau of Statistics, Treasury Department, U. S., October–December, 1883. Washington: Government Printing-Office. Pp. 160.

Geology of the Lead and Zinc Mining District of Cherokee County, Kansas. By Erasmus Haworth. Oskaloosa, Iowa: Herald Printing Co. Pp. 47.

"American Meteorological Journal," May, 1884. Monthly. M. W. Harrington, Editor. Detroit, Mich.: W. H. Burr & Co. Pp. 32. $3 a year.

Fire-Proof Buildings with Wooden Beams and Girders and Dolman's Dampers. New York: William H. Dolman. Pp. 13.

On a Carboniferous Ammonite from Texas. By Professor Angelo Heilprin, Philadelphia. Pp. 3.

"Home Science," May, 1884. Monthly. New York: Selden R. Hopkins. Pp. 112. $2.50 a year.

Report on the Cotton Production of Georgia. By E. H. Loughridge, Ph. D., Berkeley, Cal. Pp. 184, with Lithological Maps.

Recent Improvements in Astronomical Instruments. By Simon Newcomb. Washington: Government Printing-Office. Pp. 28.

Coefficients for correcting Planetary Elements. Pp. 48. Investigations of Corrections to Greenwich Planetary Observations. Pp. 56. Development of the Perturbative Function. Pp. 200. Washington: Bureau of Navigation, Navy Department.

Peabody Museum of American Archæology and Ethnology. Sixteenth and Seventeenth Annual Reports. Vol. III, Nos. 3 and 4. Cambridge, Mass. Pp. 234.

Archæological Institute of America. Reports 1883-'84. Cambridge: John Wilson & Son. Pp. 118.

Geological History of Lake Lahontan, Nevada. By Israel Cook Russell. Washington: Government Printing-Office. Pp. 40.

Synopsis of the Fishes of North America. (Bulletin U. S. National Museum.) By David S. Jordan and Charles H. Gilbert. Washington: Government Printing-Office. Pp. 1018.

Beiträge zur Kenntniss der Kobalt-, Nickel- und Eisenkiese (Contributions to the Knowledge of Cobalt, Nickel, and Iron Gravels). By Leroy W. McCay, Freiberg, Saxony.

Beiträge zur Anatomie Ancylus fluviatalis (O. F. Müller) and Ancylus lacustris (Geoffroy). (Contributions to the Anatomy of Ancylus, etc.). By Dr. Benjamin Sharp, of Philadelphia. Würzburg, Germany.

Medicinisch-Chirurgisches Correspondenz-Blatt für Deutsch-Americanische Aerzte (Medical and Surgical Correspondence Leaf for German-American Physicians), Monthly. Dr. M. Hartwig, Buffalo, N. Y. Pp. 48. $2.50 a year.

Property and Progress, by W. H. Mallock. New York: G. P. Putnam's Sons. Pp. 248. $1.

Whirlwinds, Cyclones, and Tornadoes. By William Morris Davis. Boston: Lee & Shepard. New York: Charles T. Dillingham. Pp. 90.

The Book of the Beginnings. By R. Heber Newton. New York: G. P. Putnam's Sons. Pp. 311. 40 cents.

Geological Excursions. By Alexander Winchell, LL. D. Chicago: S. C. Griggs & Co. Pp. 234. $1.50.

Warren Colburn's First Lessons (in Arithmetic). Boston: Houghton, Mifflin & Co. Pp. 216. 35 cents.

Lecture Notes on General Chemistry. By John T. Stoddard, Ph. D. The New Metals. Northampton, Mass.: Gazette Publishing Company. Pp. 84.

Home and School Training. By Mrs. H. E. G. Avey. Philadelphia: J. B. Lippincott & Co. Pp. 192.

Truths and Untruths of Evolution. By John B. Drury, D. D. New York: Anson D. F. Randolph & Co. Pp. 140. $1.

Lectures on the Science and Art of Education. By Joseph Payne. New York: E. L. Kellogg & Co. Pp. 256. $1.

Fifth Avenue to Alaska. By Edward Pierrepont. New York: G. P. Putnam's Sons. Pp. 329, with Maps. $1.75.

The Bible analyzed in Twenty Lectures. By John R. Kelso. New York: Truth-Seeker Office. Pp. 883. $3.

Government Revenue. By Ellis H. Roberts. Boston: Houghton, Mifflin & Co. Pp. 389. $1.50.

The Franco-American Cookery-Book. By Felix J. Délière. New York: G. P. Putnam's Sons. Pp. 620. $4.

Key to North American Birds. By Elliott Coues, Ph. D. Boston: Estes & Lauriat. Pp. 863. $10.50.

POPULAR MISCELLANY.

The Coming International Electrical Exhibition.—The Franklin Institute is making arrangements for the most complete representation of electrical appliances at the International Electrical Exhibition, which is to be held under its auspices in Philadelphia, from September 2d to October 11th. A place is provided on its programme for every kind of apparatus and application of electricity, with the items so grouped and arranged as to make prominent the significance and value of each. Much interest is attached to the historical collection of all first and original electrical apparatus, which will form a special department, and which the committee are endeavoring to make as complete as possible. A "Memorial Library" is also to be secured, of all publications in any way pertaining to electrical science up to the date of the exhibition—to include not only books, but also papers, reprints of articles, and notes on or relating to electricity.

Deprived of the Pleasures of Taste.—A writer in the "Cornhill Magazine" says of Harriet Martineau that "she had no sense of taste whatever. 'Once,' she told me with a smile, when I was expressing my pity for this deprivation of hers, 'I tasted a leg of mutton, and it was delicious. I was going out, as it happened, that day, to dine with Mr. Marshall at Coniston, and I am ashamed to say that I looked forward to the pleasures of the table with considerable eagerness; but nothing came of it, the gift was withdrawn as suddenly as it came.' The sense of smell was also denied her, as it was to Wordsworth; in his case, too, curiously enough, it was vouchsafed to him, she told me, upon one occasion only. 'He once smelled a bean-field and thought it heaven.' It has often struck me that this deprivation of those external senses (for she lost her hearing very early) may have had considerable influence in forming Miss Martineau's mental characteristics; but if it turned her attention to studies more or less abstruse, and which are seldom pursued by those of her own sex, it certainly never 'hardened' her."

Communication with Animals. — SIR: You did me the honor, some weeks ago, to insert a letter of mine, containing suggestions as to a method of studying the psychology of animals, and a short account of a beginning I had myself made in that direction.

This letter has elicited various replies and suggestions which you will, perhaps, allow me to answer, and I may also take the opportunity of stating the progress which my dog "Van" has made, although, owing greatly, no doubt, to my frequent absences from home and the little time I can devote to him, this has not been so rapid as, I doubt not, would otherwise have been the case. Perhaps I may just repeat that the essence of my idea was to have various words such as "food," "bone," "water," "out," etc., printed on pieces of card-board, and, after some preliminary training, to give the dog anything for which he asked by bringing a card. I use pieces of card-board about ten inches long and three inches high, placing a number of them on the floor, side by side, so that the dog has several cards to select from, each bearing a different word.

One correspondent has suggested that it would be better to use variously-colored cards. This might, no doubt, render the first steps rather more easy, but, on the other hand, any temporary advantage gained would be at the expense of subsequent difficulty, since the pupil would very likely begin by associating the object with the color, rather than with the letters. He would, therefore, as is too often the case with our own children, have the unnecessary labor of unlearning some of his first lessons. At the same time, the experiment would have an interest as a test of the color-sense in dogs.

Another suggestion has been that, instead of words, pictorial representations should be placed on the cards. This, however, could only be done with material objects, such as "food," "bone," "water," etc., and would not be applicable to such words as "out," "pet me," etc.; nor even as regards the former class do I see that it would present any substantial advantage.

Again, it has been suggested that "Van" is led by scent rather than by sight. He has, no doubt, an excellent nose, but in this case he is certainly guided by the eye. The cards are all handled by us, and must emit very nearly the same odor. I do not, however, rely on this, but have in use a number of cards bearing the same word. When, for instance, he has brought a card with "food" on it, we do not put down the same identical card, but another with the same word; when he has brought that, a third is put down, and so on. For a single meal, therefore, eight or ten cards will have been used, and it seems clear, therefore, that in selecting them "Van" must be guided by the letters.

When I last wrote I had satisfied myself that he had learned to regard the bringing of a card as a request, and that he could distinguish a card with the word "food" on it from a plain one; while I believed that he could distinguish between a card with "food" on it and one with "out" on it.

I have now no doubt that he can distinguish between different words. For instance, when he is hungry he will bring a "food" card time after time until he has had enough, and then he lies down quietly for a nap. Again, when I am going for a walk, and invite him to come, he gladly responds by picking up the "out" card, and running triumphantly with it before me to the front door. In the same way he knows the bone card quite well. As regards water (which I spell phonetically so as not to confuse him unnecessarily), I keep a card always on the floor in my dressing-room, and whenever he is thirsty he goes off there, without any suggestion from me, and brings the card with perfect gravity. At the same time he is fond of a game, and if he is playful or excited will occasionally run about with any card. If, through inadvertence, he brings a card for something he does not want, when the corresponding object is shown him, he seizes the card, takes it back again, and fetches the right one. No one who has seen him look along a row of cards, and select the right one, can, I think, doubt that in bringing a card he feels that he is making a request, and that he can not only perfectly distinguish between one word and another, but also associates the word and the object.

I do not for a moment say that "Van" thus shows more intelligence than has been

recorded in the case of other dogs—that is not my point—but it does seem to me that this method of instruction opens out a means by which dogs and other animals may be enabled to communicate with us more satisfactorily than hitherto. I am still continuing my observations, and am now considering the best mode of testing him in very simple arithmetic, but I wish I could induce others to co-operate, for I feel satisfied that the system would well repay more time and attention than I am myself able to give. I am, sir, etc., JOHN LUBBOCK.

HIGH ELMS, HAYES, KENT.

—*London Spectator.*

Gas-Poisoning. — According to statements of Professor Pettenkofer at the recent Hygienic Congress in Berlin, the poisonous property of coal-gas depends upon its containing carbonic oxide in the proportion of about ten per cent, while the other constituents, although irrespirable, do not act as direct poisons. The danger in breathing the gas depends not so much on the duration of the exposure to a mixture of air and carbonic oxide as upon the amount of the latter contained in the air. Air containing only a proportion of five parts of carbonic oxide in 10,000 can be breathed for hours and even days by men and animals without any injury to health; while a proportion of seven or eight in 10,000 causes appreciable discomfort; of twenty in 10,000, difficulty of breathing, weakness, and uncertainty in gait; a proportion of twice that ratio leads to stupefaction, and higher proportions to extreme and fatal effects referable to the nervous system. Illness attributable directly to the entrance of gas into the house from the mains has been found to increase in the winter months, largely, probably because of the closing of the windows and the artificial heating of the rooms by which the gas is attracted into them. Dr. Pettenkofer has cited several striking instances of severe affection and even death that occurred in dwelling-houses in consequence of leakage from street-mains. At Roveredo, two sisters who slept in a basement contracted severe headaches during three successive nights. On the fourth night, which was a very cold one, the mother slept with them. None of the three appeared on the following morning, and on investigation the two sisters were found dead, and the mother so nearly so that she only survived a few days. The escaping gas, under the roadway, was thirty-five feet distant from the room. At Cologne, three persons in one family were killed in a single night in 1871, by a leak ninety-eight feet away. The superintendent of a prison in Breslau died and his sons were afterward found unconscious, in the same room, in 1879, from a leak thirty-five and a half feet away. Another instance has been recorded in Breslau, where the distance of the leak was one hundred and fifteen feet. At Cologne the gas passed through a sewer-channel and through the floor, while in the other cases it traversed layers of earth. The variation in the degree of cold between one night and another, causing corresponding differences in the force by which the gas is attracted to the rooms, would, in Dr. Pettenkofer's opinion, sufficiently account for the difference in the gravity of the effects produced on these occasions. Gas filtered through the soil from the mains may be quite odorless, at least until it has collected in large amount; and herein lies the danger to dwellers in the basement. On the earliest occurrence of such symptoms as headache, the windows should be thrown open; and if, on closing them again, the symptoms reappear, it may be suspected that gas is escaping into the house.

Dr. Crothers's Studies of Inebriety.— Dr. T. D. Crothers, of Hartford, Connecticut, read before the London Branch of the British Medical Temperance Society an historical paper on the study of inebriety in America. A fact of psychological interest pertaining to the subject is, that inebriety in this country moves in waves and currents, with a decided epidemic and endemic influence. This can be traced in the rapid increase of drunkenness in towns and cities, till after a time a reaction sets in, and a marked decline follows. "These waves of inebriate storms that sweep over large circles of country are always followed by intense revivals of temperance interest, and are fields of the most fascinating psychological inquiry yet to be studied." An increase of inebriety among our women is asserted as apparent

in the great demand for narcotics, the sale of beer and wine by grocers, and the divisions of saloons by general and family entrances, with separate rooms for each. The vice is considered a pronounced form of brain and nerve degeneration coming from well-marked physical conditions, largely controlled by social and psychical states peculiar to the country. The symptomatology of the disease "more nearly resembles that of insanity and general paralysis; its course is in waves and currents; its progress is shorter; and among women the use of narcotics is more prevalent than that of other forms of alcohol." In estimating the value of remedies, Dr. Crothers believes that all efforts by moral means have failed, and are of value almost exclusively as agitations that will call attention to the evil. Legal means, by coercion and punishment, are likewise inefficacious, although there may be a value in prohibition, to be determined by the experience of the future. In his own view, inebriety being regarded as a disease, like insanity, should be, like insanity, treated as a disease; and the cure should be sought in the enlightened treatment of the inebriate asylums.

How to expose Thermometers.—Dr. H. A. Hazen discusses, in the "American Journal of Science," the conditions of thermometer exposure best adapted to secure uniform accuracy in the indications of temperature. One of the first conditions to be regarded is that of securing a good height above the ground, on which considerable diversity of opinion prevails. Much depends upon the immediate conditions of the locality. When this point is decided upon, a uniform and satisfactory shelter or screen should be provided for the instrument. The height and the screen should be so adjusted that the thermometer shall be free from the influence of ground-fog and that access of the air to it should be perfect. The shelter should shield from all reflected heat, from all direct radiation, from the sun by day, and from the earth to the sky by night, and from all radiation from surrounding objects, as well as from moisture. Many different forms of shelter have been contrived in different countries. In experimenting upon the merits of these devices, a standard of comparison is found in the swung thermometer, or, as the French call it, the *thermomètre fronde*, which is a common thermometer attached to a string or wire, and rapidly swung through a circumference whose radius is the length of the string. The theory of this arrangement is that, as the instrument is rapidly brought in contact with a large mass of air, it must give the temperature of the same unless the results are vitiated by other causes. From a number of experiments described by Mr. Hazen, the following conclusions as to the best dispositions of shelters are advanced: When exposed to direct sun-heat, they should be at least thirty-six inches long; with proper precautions the thermometer "fronde," both dry and wet, will give the most correct air-temperature and relative humidity; a single louvre shelter is sufficient. The interposition of a second louvre prevents the free access of air, and if ventilation is used it must affect the air which is propelled to the thermometer. For obtaining even approximate relative humidity in calm weather, single-louvred shelters are necessary, and for the best result an induced air-current is essential, especially in the winter in northern countries. Where a window shelter is used, there should be a free air-space of from six to twelve inches between the shelter on the north side of the building and the wall. The simplest form of screen would be four pieces of board ten or twelve inches square, nailed together box-fashion, leaving the bottom and the side toward the window open; the thermometers, dry and wet, should be placed five inches apart near the center of this screen, with their bulbs projecting below the plane of the lower edge. Shade may be given, at such times as the sun is shining on the north side of the house, by the adjustment of the window-blinds.

Numismatics in the United States.—From a paper read by Mr. W. Lee before the Philosophical Society of Washington, we learn that an extended interest in numismatics began to show itself in this country in 1858, at which time there were probably not as many as a hundred coin-collectors in the United States. The interest has grown rapidly, until now there must be on

the books of the United States Mint the names of at least one thousand collectors who receive yearly the issue of the mint, with special proof-polish. In New York, alone, during the year 1882, thirty-nine collections were sold at public auction, and brought, in all, $68,441.36. Several of our large cities have numismatic societies, some of which are designated as numismatic and archæological societies; and a number of periodicals devoted simply to the interest of numismatics obtain a satisfactory circulation.

Seasonal Variations of Rheumatism.—The records of rheumatic cases in the London Hospital fail to show any clear relation between the prevalence of the disease and particular climatic conditions. Dr. Henry S. Gabbett has compared the graphic curves representing the numbers of cases observed for nine years, and remarks a general similarity between them. In nearly every case a wave is noticed beginning to rise at the opening of summer, and reaching its highest elevation in July or August; then comes a temporary check or fall, followed by a rapid ascent till the summit is reached, at the end of autumn, when a steady fall occurs through the months of December, January, and February, till a low level is reached, which continues nearly even till about the beginning of the next summer elevation. The curves for different years do not appear to be affected by variations in the character of the seasons from which it is possible to make any deduction respecting the influence of variations of temperature or of conditions of moisture. Accepting Messrs. Buchan and Mitchell's division of the London year into six periods, each having a climate peculiar to itself, "we find that rheumatism was most prevalent in the annual damp and cold period; next in the damp and warm period; cases were about equally frequent in the two periods characterized respectively by heat and cold; below these comes the dry and warm period; and lowest of all, as regards the frequency of the disease, the period described as dry and cold. . . . It does not, however, necessarily follow that there is any etiological connection between the above facts; the periodical prevalence of the disease may possibly be independent of conditions of climate." Dr. Gabbett draws the conclusions, with a little more confidence, that the disease is neither most prevalent in the coldest months of the year, nor least prevalent in the warmest; that it does not occur with greatest frequency in those months in which the daily variations of temperature are greatest; that, although there is a certain correspondence between the rainy periods and the times when rheumatism is common, it is not close enough to point to any necessary connection. But cases of the disease are very numerous at that period of the year during which there is usually a coexistence of low temperature and heavy rainfall—viz., the end of autumn.

Shall we put Spectacles on Children?—In a paper with this title Professor Julian J. Chisholm, M. D., of the University of Maryland, makes a plea for providing children with the means of counteracting their congenital or acquired defects of vision. According to the traditions, the need of spectacles is an indication of old age, and so the world interprets it. A better knowledge, however, is diffusing itself among the medical profession, and from them to the public. While advancing years may be a factor, it is only one of many causes inducing defective vision. The action of the perfect eye conforms to the law of optics that, unless a lens focuses accurately on the recipient surface, the image made must be more or less imperfect. In front of the lens there is a broad, circular ligament of the eye, which presses against it, and, when objects at a short distance are to be looked at, by the action of a muscle (the ciliary), the compressing ligament is relaxed, so that the lens, its natural elasticity responding at once to the relief, becomes more convex, and is, therefore, in condition to focus more powerfully light coming from near objects. What is called accommodation, or ability to change the focus, is, then, a muscular act. When the accommodating muscles are temporarily enfeebled by diseased conditions of the system at large, they do not lift off sufficiently the flattening band, or they are too weak to keep up the continued action for the relief of lens pressure; hence we often find children recently recovered from an at-

tack of measles, scarlet fever, diphtheria, whooping-cough, or from any one of the depressing diseases of childhood, unable to study as they did before the attack. A weak-magnifying spectacle, by helping the muscles to do their work, will enable such children to continue their studies till tonics daily administered restore the needful strength to the enfeebled muscles. The foregoing statements are based upon perfect eyes. Unfortunately, the eyeball, with the many other features, has not always the perfection of symmetry. Near-sighted long eyes and over-sighted flat eyes are the common deviations from the standard shape. In the near-sighted eye, called *myopic*, the eye is so long from front to back that the lens is too far from the retina. The result is, that rays of light from a distant object come to a focus, and have begun to diverge when they reach the retina, so that the image formed is blurred. The second deviation in the form of the eye is called *hyperopia*. This is a flat eye, a very common form in children. It is a congenital defect, in which the crystalline lens is located so near the retina that light, passing into the eye, is stopped by the retina before it comes to a focus. This must also produce an ill-defined picture. Unfortunately, faulty eyes, which give out under use, do not appear differently from perfectly shaped ones. The flattening, or the elongation, is not in the exposed cornea. It is usually at the expense of the inner half of the eyeball, hid away in the socket. If children, either by inheritance or acquisition, have misshaped eyes, so that they can not see objects clearly through the usual range of distances, what can be the propriety of allowing them to go through life as if in a constant fog, when a properly selected glass clears up the mist, and enables them to see as others do?

Fresh-Water Pearls.—The cultivation of the pearls of fresh-water mussels has become an industry of considerable importance in Saxony and other parts of Germany. The pearls are generally inferior to those of the genuine pearl-oysters, but occasionally a gem of real excellence is produced. Some very fine settings of such were exhibited at the Exposition in Berlin. The Venetians carried on this branch of trade to a considerable extent during the middle ages, and controlled it till 1621, when the Elector of Saxony also undertook it, at the suggestion of Moritz Schmirler, a draper of Oelsnitz, and appointed Schmirler "first pearl-fisher." Schmirler was succeeded on his death by his son, and the business has continued in the family to the present day, under the superintendency of the forestry department, which has also to do with the waters of the region. The pearl-hunting is carried on in the spring, as soon as the water is warm enough to wade in for hours continuously. The mussels are examined by means of an instrument, by which the shells can be opened enough to see what is within them without hurting the mollusks. If they contain well-developed pearls, they are sacrificed; if not, they are returned to the beds. The same beds are not usually gone over again for several years. Experiments made in the Elster, in the artificial production of pearls, have not met with much success. A wound in the mouth of the mollusk will lead to the deposition of the calcareous matter, but it is uncertain whether it will be of common shell-matter or of pearl—and upon this all the value of the operation depends. In the Dutch East Indies, the formation of pearls in the pearl-oyster is sometimes provoked by inserting a grain of sand within the shell. A considerable business is done at Adorf in the manufacture of articles of fancy from the nacre of mussels.

Geological Survey of Palestine.—Professor Hull has just made a successful geological survey of Palestine, preparatory to the construction of a geological map of the country. He has traced the ancient margin of the Gulfs of Suez and Akabah to a height of two hundred feet above their present level, so as to show that the country has been submerged to that extent and has been gradually rising; and he believes that at the time of the Exodus a continuous connection existed between the Red Sea and the Mediterranean. The Dead Sea appears to have formerly stood at a height of fourteen hundred feet above its present level, or about one hundred and fifty feet above the level of the Mediterranean. Evidences of a chain of ancient lakes have been found in

the Sinaitic district, and of another chain in the center of the Wady Arabah, not far from the water-shed. The great line of fracture of the Wady Arabah and the Jordan Valley has been traced to a distance of more than one hundred miles, and the materials for working out a complete theory of this remarkable depression are now available. The terraces of the Jordan have been examined. The relation of these terraces to the surrounding hills and valleys shows that they had already been formed before the water reached their former level; sections have been carried east and west across the Akabah and the Jordan Valley, and two traverses of Palestine have been made from the Mediterranean to the Jordan.

Change as a Recreative Agent. — Sir James Paget spoke, in a recent address, at the Workingmen's College, London, on the value of change as a mental restorative, and found it to consist principally in directing the patient to some form of "work" for which he has inherited a special capacity. The effect is produced through the awakening and gratification of some dormant love or propensity which lies deep down in the individual nature and has been inherited. It thus appears that the special pleasures of individual lives are ancestral, or are "survivals in us of instincts that belonged to our distant ancestors, who of necessity had to kill, to fish, to hunt, to clear the forests, and make the roads." The mere recommendation of "change" vaguely is idle; but recreative change, judiciously recommended and specifically applied, is one of the most powerful agents we possess for the treatment of disease, or of derangements and disturbances of the mental temperament and the mind.

NOTES.

The thirteenth series of Professor C. G. Rockwood's "Notes on American Earthquakes," in the "American Journal of Science," includes seventy-eight notices of shocks that occurred on the American Continents during 1883. Of these, eight were in Canada, three in New England, two in the Atlantic States, eleven in the Mississippi Valley, and twenty-three on the Pacific coast, while the rest were in Mexico, the West Indies, and Central and South America. The more important shocks were recorded —January 11th, Cairo, Illinois; March 8th, Panama; May 19th, Ecuador; August, Mexico; and October 6th, Alaska. Most of the shocks were very moderate, and caused little or no damage.

Dr. Ernst Behm, a German geographer, died March 15th. He had been for twenty-eight years editorially connected with the "Geographische Mittheilungen" of Justus Perthes in Gotha. He was joint editor of Behm and Wagner's celebrated statistical publication.

The Trustees of the University of Pennsylvania have elected Dr. Joseph Leidy, Director, and Professor of Anatomy and Zoölogy, of the new Biological Department. Dr. J. T. Rothrock has been elected Professor of Botany; Dr. A. J. Parker, Professor of Comparative Anatomy; Dr. Benjamin Sharpe, Professor of Invertebrate Morphology; Dr. Horace Jayne, Professor of Vertebrate Morphology; and Dr. Harrison Allen, Professor of Physiology. Women are to be admitted as students.

The whole history of the once famous book, the "Vestiges of Creation," is told by Mr. Alexander Ireland, in the twelfth edition, just published. In agreement with what the world has long understood, the author is at last declared on the title-page to have been Mr. Robert Chambers. According to Mr. Ireland's account, Mr. Chambers employed his wife as his amanuensis in writing the book, and Mr. Ireland as the medium of communication with his publishers. Only four persons were at first in the secret of the authorship, of whom Mr. Ireland is the sole survivor.

Experiments by Messrs. R. Pictet and E. Yung have resulted in showing that some of the microbes at least can sustain a temperature of −70° to −130° C. (−94° to −200° Fahr.) for periods of several hours, and still live and thrive on the accession of more favorable temperatures.

It is suggested that papers will be acceptable to be read before the Anthropological Section of the British Association on American subjects, as follow: "The Native Races of America, their Physical Characters and Origin"; "Civilization of America before the Time of Columbus, with Particular Reference to Earlier Intercourse with the Old World"; "Archæology of North America, Ancient Mounds and Earth-Works, Cliff-Dwellings and Village-Houses, Stone Architecture of Mexico and Central America," etc.; "Native Languages of America"; and "European Colonization and its Effects on the Native Tribes of America." Papers should be sent in to the office of the Association, 22 Albemarle Street, London, W., on or before July 1st.

Dr. Robert Angus Smith, Inspector-General of Alkali-Works for the United Kingdom, died May 12th, aged sixty-seven years. He was the author of a "Life of Dalton," of a work on "Air and Rain," and of papers in the "Philosophical Transactions, the "Journal of the Philosophical Society," and the "Journal of the Society of Arts."

Mr. W. F. Hillebrand describes, in the "American Journal of Science," what he regards as a new mineral which he has found in connection with the sulpho-bismuthite of copper and silver. It occurs in the form of small, slender crystals, in cavities of the bluish-gray sulpho-bismuthite, which are generally bronzed by oxidation, and so deeply striated as sometimes to present the appearance under the glass of bunches of needles. Their habit is strikingly like that of bismuthinite, for which the crystals were at first taken. Analyses and the examination of their properties mark them as probably of a pure sulpho-bismuthite of copper, in the more compact portions of which silver may replace a part of the copper, while in some cases a further replacement of copper by lead takes place. No name is as yet proposed for the mineral.

At a recent meeting of the Sociological Section of the Birmingham Natural History Society, it was decided to begin immediately the preparation of an index to the study of sociology. Letters were read from Mr. Spencer, approving the system which the section proposes to adopt, and saying that time and the condition of his health alone had prevented his beginning a similar work.

M. Charles Adolph Würtz, the distinguished French chemist, whose name is particularly associated with the progress of organic chemistry during the last half-century, died very suddenly on the 12th of May last. A portrait and a sketch of M. Würtz were published in "The Popular Science Monthly" for November, 1882.

The American frigate Pensacola, passing on the 22d of December last by the Strait of Sunda, crossed large fields of pumice-stone, and continued to observe small quantities of such matter till the 10th of January, when it was in latitude 16° 7′ south, and longitude 66·8° east. The pumice was not seen every day, but few days passed without observing some; and those cakes that were seen after the 1st of January were covered with shells and plants, while some held little crabs in their pores. These pumices were derived either from the May or the August eruption of Krakatoa.

M. L. Cruls, describing, in a note to the French Academy of Sciences, the "red sunsets" as seen in Brazil, states that at first the setting of the sun was preceded by a gradual darkening caused by the interposition between the eye of the observer and the sun of a bed of absorbing vapors, having a smoky aspect, like that of "dry fog." At a later period the glow corresponded closely in appearance with the phenomenon as described in Europe. M. Cruls is of the opinion that the glow is of the same character as the twilight phenomena described in the "*Espace céleste*" of M. Emm. Lias, which, though possibly having a meteoric origin, partook of the character of atmospheric twilight.

Signor Quintino Sella, President of the Accademia dei Lyncei of Rome, died on the 14th of March. He was distinguished for valuable researches and papers of great excellence in crystallographic mineralogy, and for his active interest in the geological survey and the preparation of the geologic map of Italy. He was President of the International Geological Congress at Bologna, in 1881. To scientific eminence he added ability as a statesman; and he was for many years Minister of Finance in Italy. Men of science are invited to contribute to the placing of a bronze wreath on his tomb.

Professor Dana believes that the extraordinary rise in the Ohio River, in February last, was the result of the falling of heavy rains at a time when the ground was so solidly frozen as to be wholly destitute of the power of absorption. Compared with this, the extent of the forest region had very little to do with the height the river attained; and the same conditions of frost and heavy rain prevailing, the result would not have been materially different had the primitive forest been standing.

It is reported that a cocoanut plantation has been started on the southern coast of Florida. One hundred thousand plants have been set out on a tract of about one thousand acres, at a cost of nearly $40,000, and next winter the number is to be increased. It requires six years for the trees to begin to yield returns, but it is estimated that in ten years the grove will pay ten per cent on a valuation of $2,000,000. A full-grown tree will mature about sixty nuts annually. The Florida cocoanut-culture is limited, however, as it is confined exclusively to the sea-coast, and the trees can be grown only to a small extent in southern Florida.

Professor H. Schlegel, Director of the Royal Museum of Natural History at Leyden, died in January last. Dr. Schlegel was born in Altenburg, Saxony, in 1804, and was appointed Director of the Museum in 1858. Under his superintendence, this institution became one of the richest of the kind in existence. Dr. Schlegel was a high authority in descriptive zoölogy, especially in the department of the vertebrata.

FELIPE POEY.